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FOREST SERVICE

FOREST RESEARCH ACTIVITIES

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FOREST ECONOMICS
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FOREST RESEARCH

BI-MONTHLY REPORT

December 1, 1940

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BI-MONTHLY REPORT

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CONTENTS

	Page
General	1
Forest Economics	
Economic-Social Benefits	5
Forest Survey	6
New Public Domain	12
Forest Taxation and Insurance	14
Private Forestry	16
Range Economics	21
Forest Management Research	
Forest Fire Protection	25
Forest Genetics	31
Mensuration	35
Silviculture	45
Forest Products	
Forest Products Statistics	56
Timber Harvesting and Conversion	57
Wood Preservation	59
Forest and Range Influences	
Effect of Cover on Climate	60
Flood Control Surveys	61
Influence of Natural Vegetation on Streamflow	68
Stabilization of Soil	80
Range Research	
Artificial Revegetation	84
Grazing Management	87
Cooperating Bureau Projects	
Biology	103
Range Biology	104
Entomology	104
Pathology	109
Publications	
Manuscripts	111
Station Notes	113
In Print	114
Translations	119

GENERAL

Allegheny

Branch Stations. Both the Kane and Lebanon Branch Stations were closed for the winter months and placed on a custodial basis. All timber sales at Kane have been completed or discontinued. Weather records at the Lebanon were discontinued on December 1, while at Kane precipitation and streamflow records are being maintained by recording instruments.

An 8-foot fire line to mineral soil around the Eastern Shore Experimental Forest is being built by the State CCC camp located on the Pocomoke State Forest.

Cooperation. There is a possibility that work camps may be established by the Friends Service Committee on the Huntingdon and Eastern Shore Experimental Forests. The latter has already been inspected by representatives of that organization.

Problems and the Station's work in Pennsylvania were recently discussed by Station personnel with V L. Harper of the Washington office, and in New Jersey with A. R. Spillers of R-7.

Forest Program. Shirley, Forbes, Schnur, and Hough attended a joint meeting of the Northeastern, Appalachian, and Allegheny Stations with Region 7. Rules of forest practice were discussed for all types in this region. Hough collaborated with Jensen of the Northeastern in preparing rules for the northern hardwoods type.

Farm Forestry. The Pennsylvania Farm Forestry report on markets for Adams County was completed, and the file cards mimeographed.

Tionesta Natural and Scenic Area. Several articles were published, and one prepared for the Scientific Monthly, outlining the reasons for setting this tract aside and describing the research possibilities which exist in this virgin forest.

Appalachian

Field Trip for Women. In line with the policy of in-Service training was the trip to the Coweeta Experimental Forest, planned for the 12 women employees at the Station. On October 12, a perfect autumn day, three cars left for the field, arriving at Coweeta in time for several installations to be seen. The next morning careful demonstrations of different types of installations for obtaining hydrological and meteorological records were given and the testing station for hydrologic structures was displayed. The entire trip

was most enjoyable and every one who went has felt the benefit of seeing the field work at first hand.

Central States

Ohio Woodland Survey. The Survey reports that 75 sawmills, mostly portable, are operating in Holmes County, Ohio at the present time. The small mills and their aggregate annual cut are not reported through the Census. In this connection it is pertinent to point out that the County Agricultural Planning Report for Noble County, Ohio contains a map showing the location of 32 active portable mills in that county alone. With a large number of these small operators cutting timber as fast as it assumes tie or small saw log size, no progress can be expected in building up the growing stock to the point where regulated management can promise much success.

County Agricultural Planning. On October 9 and 10 a meeting of the State Committee on County Agricultural Planning was held at Ohio State University. Several unified county planning reports have been completed to date, and the State Committee as well as county committees are now casting about for the means of introducing an action program to carry on the plans which have been completed.

On October 10, Mr. J. F. Hull and Mr. R. E. Platter of the Farm Credit Administration, Louisville, Kentucky, accompanied M. L. Predmore, State Representative of BAE for Ohio, and L. F. Kellogg, of the Central States Station, to consider the private woodland ownerships in Ross County, Ohio. The authorization and organization of FCA is such that it provides no assistance for the private owners who desire to practice conservative cutting and woodland management and who find themselves temporarily in need of credit. In the Ohio Valley no help is available to a woodland owner in financial distress.

In November representatives of the Extension Service, Soil Conservation Service, B.A.E., and Forest Service met at the Station to plan for the fall training meeting or school for A.C.P. township committeemen. This school will be held in Ross County on December 3-6, inclusive.

On October 14 Radio Station WOSU broadcast a speech on "Why Not to Burn the Woods", which Hall had previously prepared by electrical transcription.

WPA. The WPA statistical section, directed by A. G. Adman, has been transferred to other work temporarily until a successor to Adman arrives. We have been well-pleased with the work of the WPA staff. The quality and amount of work turned out has been excellent.

Meetings. An important meeting of the Reynolds County, Missouri Land Use Planning Committee was held in October at which the State BAE representative presented a plan for increasing the grazing resources of the county through clearing and pasture improvement practices. The plan, in effect, calls for Federal investment to create public range from private forest land. No practicable program was adopted, but interested agencies are giving the problem further study.

On October 29 and 30 an effective Investigative Conference was held with Regional personnel at Rolla, Mo. Forsling and Davis of the Washington Office, Demmon of the Southern Station and Sweet of the Laboratory were in attendance. This conference was in the nature of a broad problem review, with very little attention to current research efforts. Regional Forester Price stated, "This has been the most interesting and stimulating investigative meeting I have ever attended, and I have been attending them annually for 15 years."

On November 12 Hall, Chapman and Auten participated in a well-attended conference on Spoil Bank utilization at Bloomingdale, Ohio. The conference dealt with the spoil banks resulting from coal strip mining in 7 eastern Ohio counties, mostly on calcareous soils. From the point of view of forestry, the problems presented do not appear very important. The acreages are comparatively small, and the disturbed land, with a little smoothing, seems to be more valuable for pasture than for forest production.

A meeting with State Foresters and Extension Foresters, attended by R. O. and Station personnel, took place at Starved Rock, State Park, Ill., November 18. This meeting has now become a semi-annual affair at which many problems of mutual interest are discussed with great benefit. Principal topics for discussion--(1) effectuation of the Fulmer Act, (2) effect of L. U. programs on land prices and going acquisition programs.

Personnel. J. P. Johnston was transferred to the Mark Twain National Forest October 1 where he will continue to supervise the cooperative investigative work in Missouri.

Effective November 1, E. Marshall was transferred from the Appalachian Station to the Central States Station for duty on flood control and hydrologic work.

Library. Miss Shawaker has been in charge of the library. As a part of her duties she has classified and catalogued 259 bulletins during October and November. Her efficient services as librarian have greatly increased the value of our library. This library service is a part of the current WPA project and an example of the character of WPA service we have been getting at the Station.

Lake States

The Station personnel was well represented in the attendance of the "School of Philosophy" sponsored by the local U.S.D.A. Club and the Department of Agriculture, which was held at the University of Minnesota late in November. During the progress of the sessions the Director was able to persuade such distinguished visitors as Dr. Mordicai Ezekiel and Personnel Director Hendrickson to visit the Station and meet the staff.

Northern Rocky Mountain

The technical personnel at the station were able during the past summer to spend an almost uninterrupted season in the field on project work. Men from some of the divisions were in the field from April to the end of November. Few field assistants were employed because of limited funds, but the number of project leaders and technical workers who spent the bulk of the season in the field numbered 26. The two experimental forests and the two experimental ranges were manned and all of the essential work at these research centers carried on. The Forest Survey division had, in addition to their field crew, an office force for report writing and office compilation and analysis of 4 regular and 4 to 5 State WPA employees.

Station men spent a total of 61½ man days on fire suppression during the past fire season. Due to the fine work of the protection men in the region, it was not necessary to call on station men except during a few highly critical periods.

In addition to their regular project work, a number of men at the station have contributed a considerable amount of time to the national forestry program. Much basic information on the forest resource and the situation has been made available for use in the educational program. Bradner made several trips with regional men inspecting the present forest practices on private lands.

Most of the men are now in Missoula for the winter's job of compiling and analyzing the field data collected and in writing reports. The organization here in Missoula now numbers 40, of which 12 are WPA workers. Four men are on educational leave attending universities.

Pacific Northwest

The Division of Forest Management participated in a number of meetings and field trips jointly with the Regional Office. Among these was a series of trips, participated in by about 8 to 12 forest officers, to the principal selective logging national

forest timber sales in the Douglas-fir region, primarily to discuss slash disposal and secondarily the silvicultural method of cutting. The Director, Munger, and Matthews each participated in some of these very profitable field conferences. Briegleb represented this division at a 3-day meeting of the Oregon State Land Use Committee, which made its field headquarters at the Pringle Falls Experimental Forest for two nights. Briegleb also spent a half week on the trip of administrative and research specialists to the Kaniksu and Colville National Forests, particularly to decide upon land use policy for the Dollar Mountain burn on the latter forest.

Munger attended, as an unofficial delegate, the Pacific Logging Congress in Victoria where there was an unusually good discussion of slash disposal occupying the best part of a morning.

An issue of Forest Research Notes, which was devoted wholly to the results of studies by this division and containing nine articles on growth, silviculture, and stand improvement, has been prepared for general distribution.

FOREST ECONOMICS

ECONOMIC-SOCIAL BENEFITS

Allegheny

Anthracite Survey. Field work in the forest inventory of Luzerne County is now 82 percent complete. Continuance of the project to completion is now definitely assured.

Working plans for a county study of drain, and certain types at least of requirements, combined with investigation of the labor employed in local forest industries are in preparation. R. W. Nelson of the Washington office visited the Station in this connection, and Forbes took advantage of his attendance on the R-7 meeting with the northeastern experiment stations to discuss relevant data collected by the Region.

Beck has revised his office report on forest taxation and forest ownership in the anthracite region, as a preliminary to a Station release of the more significant data.

Promising contacts have been made with the Anthracite Institute and the Committee of Twelve of the anthracite industry. The latter, comprised of equal numbers of operators and labor union officials, administers the present wage agreement in the industry.

Through our Anthracite Survey Note No. 2 it has become interested in the possibility of diverting substantial numbers of those engaged in "bootleg coal" activities into construction of physical improvements needed in fire protection, and perhaps other forest projects. Recent contacts with a forester employed for many years by one of the largest and most progressive coal companies have fortified our belief in the worth-while-ness of these projects.

The Survey benefited from a visit by V. L. Harper of the Washington office, and by contacts with FCS men engaged in the examination of the locally important Solomon Creek watershed. This examination we hope will yield concrete information on employment of labor in phases of forestry work for which it is now very difficult to estimate labor requirements, but which promise to become of major importance to the anthracite region.

FOREST SURVEY

Appalachian

General. The accelerated industrial tempo of the defense program has had a very noticeable effect on wood-using industries in the Station's territory. In some localities, the price of roofers has jumped from $12 - $15 per thousand feet a few months ago to $25 - $30. Other grades of lumber also show substantial price increases. Mills are running at capacity and stumpage is in demand. Requests for Survey information have greatly increased, particularly for information regarding the location of timber stands, average volumes per acre, growth rates, stumpage prices and names of operators cutting certain species or grades. Several "feelers" have been received from pulp and paper companies interested in locating new mills in this region.

Inventory. Inventory field work in Virginia is on schedule with approximately 95 percent of the state covered. The remaining lines should be completed by mid-December.

Preliminary tabulations of the Virginia Coastal Plain region show that 62 percent of this 6½-million-acre unit is forested. The distribution of forest types and condition classes based on cubic feet is as follows:

Forest types	Percent
Loblolly pine	49
Shortleaf pine	4
Virginia pine	8
Upland hardwoods	23
Bottomland hardwoods	16
Total	100

Condition classes		Percent
Sawlog size		
Old growth	3	
Second growth	60	
Total		63
Under sawlog size		
Second growth	33	
Reproduction	4	
Total		37
		100

The proportion of old growth (3 percent in this unit) is the lowest of that in any coastal unit covered by the Survey to date and indicates the intensity of past timber operations in this region.

Drain. Arrangements have been completed to cooperate again with the Bureau of the Census in the 1940 Census of Lumber Production. This Station will make a complete field canvass of all primary wood-using plants in Virginia and will edit mailed questionnaires in North and South Carolina and do such field checking of delinquents in these states as is necessary.

Reports. Forest Survey Release No. 6, "Forest Resources of the Piedmont Region of North Carolina," was issued on November 15. Although this unit is one of the most intensively developed industrial and agricultural areas in the South it is still an important timber producing area. Nearly one-half of the land area is forested, chiefly in the form of farm woodlands, with a total volume of 11 billion feet of sawtimber. Approximately 1,600 sawmills operated in this unit in 1937, a mill to every 3,100 acres of forest land, and cut 624 million feet of lumber. A number of other mills produced veneer, small dimension stock, handles, shuttles, staves, baskets and miscellaneous products. Approximately 15,000 men were employed by these primary wood-using industries in woods and mill.

A comparison of increment and drain for 1937 shows a considerable over-cut in pine, the principal commercial species. The report brings out that corrective measures such as more intensive fire control, expansion of the farm forestry program, and control of small mill cutting practices are necessary tc prevent deterioration of the timber stands.

Lake States

In response to demands from county planning groups for forest information upon which to base plans for lands zoned out of agricultural use, the Station is experimenting with county forest-survey reports. The inventory phase of the original Survey was developed for economic units embracing 2 to 10 or more counties. Where good cover type maps are available, it is believed that the estimates for the units can be broken down by counties with sufficient accuracy to meet the immediate needs of the planning groups. The Survey record of forest industries can readily be presented by counties.

In Carlton County, Minnesota, the first county in which localization of Survey data has been attempted, the Station has a fairly good type map assembled from various sources, including some original surveys in which Agricultural Adjustment Administration airphotos were employed. A few days' field checking indicated that the per-acre volumes for the forest-survey unit were applicable to the types in the county. Thus a county estimate was prepared. Figures were also assembled on land ownership, local wood requirements, local stumpage values, and the relationship of woods work to local agriculture.

When a draft of the Carlton County report was finished the State's Bureau of Agricultural Economics representative, Mr. Gilcreast, arranged a meeting in St. Paul to discuss the implications of the data. Members of the Extension Service, State Forestry Department, Forestry Division of the University, and of the Lake States Station, took part. The conclusions of the group were:

1. Carlton County, one of the most completely cutover and burned counties in the State still has potentiality of producing large quantities of pulpwood fairly soon if the large acreages of 3- and 4-inch aspen, jack pine, spruce, and balsam are protected from fire and premature cutting during the next 10 or 15 years.

2. The county would be justified in employing a county forester to look after 150,000 acres of cut-over land which have reverted for nonpayment of taxes. Within a few years revenue should more than cover costs of administration.

3. The State Conservation Department should cooperate with county officials in developing an effective system of small timber sales, as well as in prevention of trespass and fires.

4. Extension agencies and the University should encourage logging and other forestry work either on farms or on adjacent public forests as a logical part-time job for many farmers.

5. Research agencies should explore further the costs and returns from various combinations of farm enterprises in forest-farming portions of the county.

Northern Rocky Mountain

General. In late October Mr. Garver spent a week at the station reviewing the local survey work. During this time he reviewed and commented on the revised forest survey report for northern Idaho and discussed plans for further survey work. It was tentatively decided that, owing to the demand for extension of survey in other regions, survey work in Eastern Montana could not be financed immediately with regular funds allotted to the Survey.

An initial allotment of WPA funds was secured for this purpose and a man experienced in survey procedure in this region was employed to supervise WPA workers in several eastern Montana counties. A forest school graduate was obtained from a local WPA register to assist in the technical supervision work.

Eastern Montana forests are concentrated on the higher, more or less scattered, mountain masses. The intervening territory is chiefly grazing land. Accordingly, aerial photographs taken recently in connection with the AAA program are being used to locate the boundaries between grazing and timberland. The amount of field work involved in mapping is thereby greatly reduced; the timbered areas will, of course, be examined on the ground to identify and map in existing forest types. Commercial timber will be estimated in the usual fashion.

During October J. W. Girard spent approximately 10 days with survey men making field checks of survey cruises on the St. Joe National Forest in northern Idaho.

Inventory. The 1940 field season closed on November 27 with a total of 2,808,000 acres mapped in place. This area includes all of Missoula County, all of Lewis & Clark County west of the Continental Divide, and approximately 50 percent of Powell County. It is estimated that the area west of the Continental Divide in Montana can be completed with the present field force during the next field season.

The field work in Eastern Montana was initiated in Fergus County on November 12.

Reports. The second draft of the Forest Survey report for northern Idaho was reviewed by representatives of local private industries and state and federal agencies interested in the forest situation. Winters and Hutchison personally visited most of these

commentators and discussed the various controversial aspects of the report with them. Their comments are being given serious consideration in the third revision of the report.

Pacific Northwest

General. Garver spent ten days in the region reviewing survey work in the office and field. During his visit reviewers' comments on the manuscript of the ponderosa pine regional report were considered and plans made for amendments to meet comments.

Douglas-Fir Region

Keeping Findings Current. Field work was completed in Wahkiakum County winding up the field season.

Summary of type areas was completed for Lewis County and volume compilation about 60 percent completed. Work of determining type areas has commenced for Benton, Polk, and Wahkiakum Counties. One-inch-to-the-mile type maps for Kitsap, Mason, and Wahkiakum Counties were completed.

Interpretation and Analysis. Page proof of "Forest Resources of the Douglas-Fir Region" was returned to the printing office late in October and final publication should not be far away.

Revised "Forest Statistics for Clallam County" was issued.

Outline of a proposed comprehensive report for the "Grays Harbor Unit" was reviewed and assembly of data is commencing.

Southern

General. Captain Eldredge delivered two addresses during this period, one to the students of the Alabama Polytechnic Institute at Auburn, Alabama on October 3, entitled, "Forest Resources of Alabama," and one before the National Association of State Foresters, at Gulfport, Miss., on October 8, entitled, "The Forest Survey in the Lower South". He also prepared an article, "A Forester Reviews the Parade, " to be sent to the Southern Lumberman for inclusion in their Christmas issue. Articles for the same issue of the Southern Lumberman were also prepared by Smith and Stover entitled, respectively, "Trends in the Primary Forest Industries of the Lower South" and "How Timber Growth and Drain in the Lower South are estimated by the Forest Survey."

Reports and Releases. Wheeler continued work on Mississippi Unit #2 report manuscript and completed the final check of Release No. 51, "Primary Wood-Products Industries in the Lower South," which was then multilithed under date of November 29. Word came from Washington that the proofs of the combined unit report of Georgia Units #1 and #2 had gone to the printer and that the report would probably be ready for distribution within a month.

Interpretive Section. Ineson continued work on naval stores analyses and on material in connection with the study of the financial structure of wood-using industries. He also conferred with several visitors, among whom were Traux, Schlatter, and Hawes.

Work was inaugurated under Ineson's supervision on a study of the distribution of important southern timber species in the Southern Survey territory, using the immense amount of data available in the Survey's line plot records. Work maps were completed of the distribution of longleaf pine in Georgia, about half of Alabama, and half of Florida.

Drain and Industrial Section. Harry Smith spent two weeks in Washington, during which time he discussed with Mr. Garver and Mr. Steer cooperation with the Bureau of the Census for 1940. He visited both the Bureau of the Census and the Interstate Commerce Commission in connection with his industrial drain studies for the South. Following Smith's visit to Washington, an agreement was entered into between the Forest Service and the Bureau of the Census for cooperation in gathering 1940 data on the forest products industries of the eight states in the Southern Forest Survey territory.

Reports. Forest Survey Release No. 51, "Primary Wood-Products Industries of the Lower South" by H. F. Smith, gives the latest available data on the 8,000 sawmills, 9/10 of which cut less than 20 M per day, and other forest industries of the Southern Survey territory. The total volume of wood cut from the sound tree growing stock in 1937 for industrial and domestic purposes was 41 million standard cords and was distributed among the various commodity uses as follows: lumber 53.4 percent; ties 7.2 percent; pulpwood 5.0 percent; veneer 3.2 percent; cooperage 2.3 percent; poles and piles 1.4 percent; miscellaneous commercial uses 1.1 percent; fuel wood 19.6 percent; fence posts and miscellaneous farm uses 6.6 percent.

Between 1935 and 1940, 45 large mills, including the largest mill in the South, ceased operations, but the number of small mills is steadily increasing.

The pulp industry leads in capital investment and value of products. Since 1935, 11 new mills have been built and are in production and 4 additional mills are under construction (1940). Several of the 25 mills now operating have increased their capacity in the last 3 years. Other forest industries which are also expanding are: wood preserving, wood naval stores and veneer, each of which shows an increase in number of plants since 1935.

The number of man-hours of gainful employment provided by cutting and processing a volume of wood equal to one standard cord by the major forest industries is shown in the following table:

Number of man-hours employment provided by each unit of volume (cord) cut and processed by major industries in the South

Industry	Man-hours of labor per unit volume
Pulp and paper	27.7
Veneer	23.3
Cooperage	18.2
Lumber	13.7
Cross ties	10.4
Poles and piles	9.0

NEW PUBLIC DOMAIN

Pacific Northwest

In preparation for publication of New Public Domain material, an abstract was prepared of each of eight preliminary reports which might be issued, followed by a condensed formal report. Each "preliminary" would be complete in itself, and while all of them constitute a well-designed series, there would be no indication or need of continuation from one to the next. The season finds us cooperating with others in formulating principles underlying sound legislation applicable to the New Public Domain problem. Among these measures are disposal of tax-forfeited lands, State acquisition including settlement of tax equities, ways and means of acquiring lands including State forest utility bonds and rural zoning. In these undertakings for Oregon, the State Forester, Regional Office of State and Private Forestry, and this Station were jointly engaged in cooperation with the Governor's Economic Council, the Portland Chamber of Commerce, and others.

Looking at several measures suggested by private and public groups, devolution of legislative authority looms as one of the issues with which the 1941 Oregon Assembly will deal. This issue is

noticeably traceable in the pattern of measures pertaining to tax delinquency, tax reversion, tax-forfeited lands, land settlement practices including rural zoning, and forest practices including fire protection. From the beginning Oregon has followed a trail along retention of legislative authority in the legislature and the people by meticulously defining conditions under which certain acts or things are lawful or unlawful, leaving to administrators no more than the determination of the fact as to when these conditions obtain, and making such determinations subject always to judicial review. It has avoided in marked degree vesting administrative agencies with broad discretionary powers to enact and enforce regulations which would in any way be interpreted as bordering upon the use of legislative power even though such regulations were essential in the determination of some facts or state of things upon which the law intends to make its action depend. Oregon laws are apt to cover exhaustively the conditions, contingencies, exigencies, and state of facts upon which administrative action may be taken, leaving little to be filled in by administrative regulation. Consequently, they tend to blanket the whole State with a uniform rule of action that allows little deviation in administrative application to changing or peculiar local conditions. But with increased social and economic complexities, and hence increased variabilities between localities moving in the field of public convenience as well as in the field of public necessity, has come a growing persistent call to allow administration greater discretionary powers and to permit statutory law to be supplemented by administrative law to a much greater extent than heretofore. At this point another important issue crosses over which is related to devolution of legislative authority--that of judicial review of practices under administrative law versus letting administrative law develop its own procedures. A third crucial but more poorly defined issue is thrust in at the same point; this one has to do with jurisdictional prerogatives of the various levels of government in the field of public administration. To what extent the three issues will interact is unforeseen and unpredicted, but of a certainty the Oregon trail now leads us to a somewhat confusing intersection which will be interesting and important for all to watch.

Land Planning. Cooperation in land planning continued with the Bureau of Agricultural Economics, the Soil Conservation Service, and the Pacific Northwest Regional Planning Commission. It consisted largely of supplying basic data, analyzing and synthesizing some of the material, and in general reviewing manuscripts and outlines. Continued cooperation in agricultural planning within forest counties gives rise to questions about perspective. In this work are we not prone to treat rural lands as sufficient unto themselves and to ignore urban dependencies upon forest land use, to treat the rural as something almost foreign to the urban, to forget the sources of urban welfare, to forget that sawmill and pulpmill

cities exist largely because of the forests on rural lands, to forget that without the forests these cities would disintegrate and that without these cities local markets and possibly foreign markets for rural land products would approach zero? Although the forester is usually aware of close urban-rural interrelationships, several of the documents reviewed appear to reflect little or none of this awareness. Reports lack reality when urban-rural interrelations are not reflected--when they are not brought into proper perspective. Their intangible nature does not make them unreal--a debt though intangible is one of the most forcefully real things men and nations face.

FOREST TAXATION AND INSURANCE

Pacific Northwest

"Rural Property Tax Rates for 1940 in Oregon and Washington Counties" is the title of a report which was completed and multigraphed and distributed in November. It was reviewed in the November 23 number of the Oregon Voter. In spite of a rather wide distribution (500 copies) a large number of requests for copies have been received from persons not on our mailing list, because of the review in the Voter. Requests are coming principally from superintendents, principals, and other school officers. The most striking fact revealed by the study is the great range in tax rates among different parts of the same county. Because this range is due principally to the methods of school finance, the report has been of special interest to school administrators.

There has been continued interest in this region in the subject of national forest contributions in lieu of taxes. The Association of Oregon Counties has an active committee working on the subject. The Bureau of Municipal Research and Service of the University of Oregon is attempting to find the value of national forests and other tax-exempt property in selected counties. The Portland Chamber of Commerce is actively interested. There was a feature article in the Sunday Oregonian of November 3 regarding the tax exempt nature of national forests, which was reprinted in the Congressional Record. The Station is keeping itself informed regarding these activities and working with the Regional Office in making the results of research on this subject available wherever the opportunity is presented.

Southern

Field work in Craig's tax-index study was resumed in Alabama in October. Data on assessed values and taxes per acre of forest land have been obtained since then in Colbert, Tuscaloosa, and Blount Counties, and work is now in progress in Coosa County. Later, the study will be extended to Barbour, Choctaw, and Jackson Counties. The completion of these counties will provide information on the average assessed values and average ad valorem property taxes per acre of forest land for the period 1937-1940, with related indices, in nine Alabama Counties in all parts of the State and in each forest region. The results will be published as an Occasional Paper of the Southern Station.

While it was possible, in the first two counties studied (Escambia and Butler), to arrive at separate assessed values for forest land in various condition-classes (as discussed in previous reports on this study), such separation has been found impossible in the subsequent counties because of the Alabama system of blanket assessment of all real estate owned by a given tax-payer in the county as a whole. It has, therefore, been necessary to preselect sample properties known to consist solely (or nearly so) of forest land in fee simple or surface title (i.e., with no inclusion of subsurface titles in the total assessment), and to base the average assessed value of such forest lands on the average for the whole county ownership held by the given owner. Obviously, such an average, particularly if the holding be large, may include all classes of forest (sawlog to clear-cut). For this reason, this study in Alabama will be able to derive and report data based only on all forest land in a given county rather than data for each type and condition class separately. For this latter reason, it has been determined to add to those originally chosen two additional counties, Choctaw in the southwestern part of the State, shortleaf loblolly pine and bottomland hardwood types, and Jackson in the extreme northeastern part of the State, upland hardwood and shortleaf pine-hardwood types; also to attempt to obtain valid data in Barbour County (southeastern part of the State, shortleaf-loblolly pine type) if properties can be found sufficient in number for an adequate sample which do not include crop or pasture land under a blanket assessment. It is hoped to complete field work by February 1, 1941.

California

For the past several months the Division of Forest Economics has been undergoing a period of reorientation and adjustment. Mr. C. L. Hill, who had charge of the forest products research at the Station for many years, also supervised the economics work until he took over a special assignment in the Director's office last year. Dr. H. R. Josephson continued to carry on the economics program until he resigned from the Forest Service last summer to accept a position as assistant professor of forest economics at the University of California. In August, Mr. Edward C. Crafts was appointed to the Station staff to assume leadership of the economics work. He comes to California after a year's furlough for graduate study in forest economics at the University of Michigan prior to which he had been attached to the Southwestern Station for a number of years in range research.

Marketing Survey. In connection with land utilization studies in the western Sierra Nevada foothills, and with the possible development of a farm forestry program in that area, a special survey of marketing conditions for second-growth timber has been completed. The personal interview method was followed and data were obtained regarding operating practices and equipment as well as marketing conditions. Sawmills, mine pole operations, mines, box factories, veneer plants and various miscellaneous operations were included in the survey.

Approximately five to six million feet, board measure, of second-growth timber were cut by some 30 to 35 small sawmills in 1939. These mills, which were generally of small capacity and low output, were also often poorly equipped and financed with the result that they put out a low-grade product. Nevertheless, because of their location, size, and portability, the small mills appear best adapted to the utilization of second growth. Many of the larger operators are turning against second growth because of seasoning difficulties and alleged technical deficiencies in the wood. Second-growth lumber finds a stiff competitive market from the local old-growth pine, and even from Douglas fir shipped in from the Pacific Northwest.

The levelling off of the recent mining boom in the Sierra foothills, and completion of local construction accompanying it, has resulted in a decline in local demands for lumber cut from second growth. Also, box factories which absorbed a considerable volume of the lumber produced by some mills have turned against second-growth box lumber because of complaints about its hardness and tendency to split, and because of the unreliability of the

small mills which supply it. This declining market has caused an unstable and depressed condition in the small sawmill industry of the region.

The mine pole industry has for many years been on the decline, partly because of the decrease in mining activity, but largely as a consequence of the influx of Douglas fir from the Northwest. Not only has there been a reduction in number of operators, but the annual production per operator, and the prices received have also declined. Less than 1,500,000 lineal feet of mine poles are estimated to have been produced by the 17 to 20 operators still active in 1939.

Fuel wood for both heating and cooking has suffered a tremendous decline in markets under the strong competition of piped and tanked gas and fuel oil. Oak from the lower foothills is the principal fuel wood having general local acceptance, but digger pine, second-growth ponderosa pine and manzanita are also used widely, though in smaller quantities. There is no favorable prospect for an increase in the fuel wood market.

The piling industry holds the best promise for an immediate large market for second-growth timber. As a result of the present National Defense Program there has been increased construction of docks, piers and other waterfront developments that require large quantities of piling. One operator is cutting 12,000 piles annually, which average 65 to 70 feet in length. Although this market has a bright immediate future, it also has the disadvantage of being rather temporary in nature.

The best prospect for an enlarged permanent market for second-growth pine appears to lie in its use for veneer in making boxes and veneer baskets. One operation for example consumed 300,000 board feet of veneer bolts in 1939, while another plant consumed over 1,000,000 feet. Second-growth ponderosa pine is in some respects admirably adapted to this use, and although the market is limited to date, it offers the best prospect of permanent improvement.

Central States

On the Illinois farm woodland study the final outline is prepared, all forest tables relating to stand structure, regeneration, growth and log-and-tree quality have undergone their first typing. Some compilation remains on the productivity of pasture areas and building structure investment. Final tables for forest products remain to be done. Incidentally, 83 forest farms in Bureau, Fulton and Schuyler Counties showed an over-all deficit

of nearly 25 percent above annual growth for home requirements alone--based on 1938 consumption data. Of course, individual farms and counties show considerable variability in this respect. In this part of the Corn Belt, at least, the woodlands are not very productive, either.

A Working Plan was prepared for the forest economics phase of the Sylamore Experimental Forest sale. Data were gathered from the operator, the Ozark National Forest and personal observation for the preparation of hourly costs for the breakdown to be recognized in the logging and milling.

Lake States

Michigan.--Carl Holcomb finished field work on the cooperative farm-forestry project in Michigan about October 1. Preparation of a report to be published by Michigan State College on "Markets for Farm Woodland Products" is well advanced. Indications are that the failure of wood-using industries in lower Michigan to make greater use of local timber is due chiefly to (1) lack of adequate grading of lumber sawed in portable mills, (2) improper seasoning, (3) lack of reliable sources of supply. The 850 wood-using industries in the southern portion of the State provide an outlet for considerably more lumber than is now being taken from local woodland if these deficiencies can be overcome.

Minnesota.--Surveys of present wood uses and requirements on 120 farms in Winona County recently completed by Charles White show that a substantial deficiency has accumulated during depression years in use of wood for maintenance and replacement of farm buildings and structures. Case studies show also that large savings in the costs of material and labor can be had with use of locally produced lumber. These studies of use of local woods on the farm have caught the interest of the Extension Division of the University and the County Agricultural Committee, with the result that a joint extension and research project in a self-help building and repair program is being planned for the coming year in Winona County.

Wisconsin.--The research methods which have been worked out for the pasture-woodland project in Wisconsin was the subject discussed by H. C. Moser at the Station's semi-monthly seminar on November 13. One of the most difficult problems encountered during the first six months of field work has been the development of a practical scheme of classification for grazed woodlands. It has been concluded that a dual classification is necessary, based upon the character of both the overstory and the forage cover. Such a dual scheme is required because the forage yields

are affected not only by the density of tree cover but also by the intensity and duration of past grazing. This method will enable comparison to be made between forage yields and timber yields as measured independently on different grazed woodlands of similar classification.

The rugged terrain of southwestern Wisconsin produces wide variations in the factors affecting the quantity and character of forage yields from both open and wooded pastures. Because of this complexity of site factors, studies are being restricted to north exposures and middle slopes. A dozen 5-acre pasture plots were established during the first season on open hillsides. In these pastures milking cows will be used to measure forage yields in terms of livestock grazing days. For ungrazed woodlands, yields will be measured by means of clipped quadrats, the clippings to be chemically analyzed to determine nutrient contents, which can be converted into terms of grazing days.

For measurement of timber yields, a large number of small, temporary sample plots are being measured throughout the district. Yield tables for fully stocked and partially stocked woodlands will be developed. These will be applicable to any stand which may be encountered in the area. Numerous small plots also are being established in grazed woodlands, to determine the rate of natural regeneration and the change in timber growth rates following exclusion of livestock.

Woodland phases of the project are being handled by Moser and Farrington from the Station, while pasture phases are supervised by Professor Henry Ahlgren of the University of Wisconsin.

Northeastern

Farm Forestry - Connecticut. Plans for equipment for conveying and stoking hogged wood are now in the hands of a consulting engineer who is checking them. The plans represent a considerable amount of exploratory work in corresponding and conversing with manufacturers of equipment, and the work has been carried about as far as is possible without the aid of a competent engineer. Surprisingly little is known by heating engineers in New England in regard to the use of wood as a fuel for the larger boilers such as are used for institutional heating.

Arrangements have been completed for studies of cost of hogging wood. Actual operation of the hog is expected to start about December 15.

Since the last bi-monthly report was submitted, it has been announced that the manufacturer of the Char-Wood Heater has discontinued production of these stoves due to war orders for other products. At the present time, Professor Seeley of Yale University, the designer of the heater, is attempting to interest some other responsible concern in its manufacture.

Fuelwood production time studies are continuing as planned. All hand tools have been tested but no significant saving of time has been discovered. Skidding and hauling tests are nearing completion. The first tests made with a new logging arch and with a sled equipped with cross-haul mechanism indicate that some changes in design to strengthen some parts are necessary before further tests can be made. A power drag saw has been used and indications are that some savings can be effected with trees of diameters over 12" by skidding in tree lengths to the saw.

The portable charcoal kiln continues to indicate that the efforts so far expended have been pointed in the proper direction. A number of charges must still be run to gather more data. When definite knowledge is available concerning the operation of the present kiln of one cord capacity, a design will be prepared for a kiln which will be truly portable and of a size which will give maximum results in quality and quantity of charcoal produced.

Southern

Reynolds reports that at Crossett, Arkansas, frequent rains during the summer and fall have entirely eliminated the usual serious fall fire season. The Crossett Lumber Company has lost only 60 acres by fire since April 1940 on its large holdings.

Reports from southern Arkansas also indicate that last year's excellent seed crop of loblolly and shortleaf pines, followed by a summer and fall with frequent rains, has resulted in a good catch and good survival of pine seedlings and promises an abundance of well restocked stands for forest owners throughout the area. This gift of nature, however, calls for even greater efforts in fire protection since fires during a single dry season can wipe it all out.

RANGE ECONOMICS

Intermountain

Size of Livestock Enterprises in Central Utah. The increased interest in area economic studies in the last ten years has resulted in the development of various procedures for handling basic information on farm and ranch organization. One of these procedures is the classification of ranches according to size of operation in the public range land areas of the eleven western states. Unlike other regions of the country acreage of land owned or leased does not necessarily indicate the size of the operating units. For example, on the east desert of Utah there is a ranch running approximately 1,100 head of cattle that owns only 640 acres of land; controlling springs, wells, and stock water reservoirs which entitle them to grazing privileges on the public range sufficient to operate their livestock throughout the year. In an adjacent locality there is an operating unit running 3,000 to 4,000 head of cattle which owns and leases 36,000 acres of land in addition to its public land grazing privileges. Comparable variations in the amount of land controlled exist in all sizes of ranch operations. In ranching areas the number of livestock operated is the most desirable indication of the size of operating unit.

Some pertinent observations on the development and use of size classes of range livestock enterprises have been secured from an area economic study being conducted in central Utah. This study area includes the Fishlake and Manti National Forests and the Pahvant and San Raphael Grazing districts.1/ Practically all of the beef cattle and sheep raising operations secure at least part of their year's feed requirements from the public ranges. It is characterized by an extremely large number of very small operating units, but there are also a few large ranching operations.

With such a wide range in the number of livestock operated the establishment of size classes involved considerable study so as to secure groupings of operating units that would represent all the typical sizes of farm and ranch livestock operations. An essential factor in the establishment of size classes for livestock using the range forage is that each classification represents a definite size of farm or ranch livestock enterprise. Frequently classes are developed so as to secure a fairly uniform number in each class or so as to have the trend in number of units within the various size classes decrease from the small to the large operations. Such a procedure may be desirable but it is more important that each group represent a definite size of operation common to the study area.

1/ Formerly Utah Nos. 3 and 7 Grazing Districts.

In the area being studied it was necessary to have several classes for small set-ups since there are a number of kinds of small farm livestock operations along with the different sizes of ranches. The following size classes were established for cattle and sheep operations:

I. Cattle

A. 1 to 20 head of cattle. This represents the small, uneconomic farm herd of beef cattle.
B. 21 to 40 head; the economic farm herd size of operating unit.
C. 41 to 70 head; the large farm herd size of cattle.
D. 71 to 100 head; the small cattle ranch operation.
E. 101 to 200 head; the family-sized cattle ranch operation.
F. 201 to 600 head; the larger family-sized ranch and probably the most efficient size of specialized range cattle operation.2/
G. 601 to 1,000 head of cattle; representing the small corporate or speculative-sized operation.
H. Over 1,000 head; the larger, more speculative type of cattle operation generally based on large amounts of borrowed capital.

II. Sheep

A. 1 to 100 head of sheep; the small farm flock size of operating unit.
B. 101 to 300 head; the large, economic-sized farm flock.
C. 301 to 700 head; the large farm flock or small uneconomic range band operation.
D. 701 to 1,500 head; the one-band size operation.
E. 1,501 to 2,500 head; the two-band, family size operation.
F. 2,501 to 5,000 head; the most efficient size of range sheep operation, three to five summer bands.2/
G. 5,001 to 10,000 head; the smaller corporate or speculative size of sheep operation.
H. 10,000 head; the larger, more speculative-sized sheep operating unit, generally based on large amounts of borrowed capital.

As will be shown later on, sheep are more frequently run in relatively larger and more economic-sized operating units than are cattle. These various categories provide a satisfactory classification for this area where there are so many small enterprises using the public ranges. The smaller size classes used in this study would not be necessary in most other western range areas since the farm-sized operations are not so common.

2/ Defining efficiency strictly in entrepreneurial terms.

A discussion of some of the problems involved in the determination of the size of operating units in this area is pertinent. In order to reduce the time and expense involved in securing livestock numbers directly from farm and ranch operators, research workers have frequently used secondary sources of data such as grazing permits on the national forests and the grazing districts. The economic study previously referred to has brought to light some rather serious objections to this procedure, at least for the area being studied.

Over 80 percent of the permits, based on the size of permit,3/ for cattle and sheep on the Fishlake and Manti Forests, are for less than 41 cattle or 301 sheep. These permits account for 47 percent of the sheep and 64 percent of the cattle grazed on the forest. These two forests represent an extreme situation in the Intermountain region, and with but a few exceptions also for the United States, in having such a large number of extremely small permits.4/ This situation has been created by a number of factors, two of the most important of which are listed below. One, the past policy of the Forest Service was to distribute grazing privileges so as to assist in the development of as large a number of family-sized operating units as was consistent with the resources of an area. Two, originally larger permits have been broken up by dispersion to heirs which has been fostered by the kind of agricultural operations and social organization in central Utah.

From charts showing the percent of operating units and livestock numbers by size classes based on the number of livestock actually operated, it is apparent that the actual size of enterprise using these two forests is considerably different from the size of grazing permit. This is especially true for sheep.

There are a number of causes for this marked difference. A major cause is that most operators own more livestock than they have a permit for on the forest. Furthermore, the smaller operations tend to have a larger percentage of the stock they own on the forest than do the larger operating units. This same situation has been found in other economic studies in public range land areas of the West. A second cause is that in many cases two or more permits are held by one operating unit. There are approximately 2,600 permits on these two forests but only 1,700 operating units. This means that 900 of the permits are not operating units. Common examples of this combination of permits are where a man and wife each have a permit or where a man, wife, and sons each have permits but they are one operating unit. This situation has been created

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3/ Source: 1939 grazing permits on the Fishlake and Manti National Forests.

4/ The Intermountain region includes Utah, southwestern Wyoming, Idaho south of the Salmon River, and Nevada except for the extreme southwestern border.

by permittees splitting their permits up among the family in order to be under the protective limit and thereby avoid distribution reductions. Then, there are cases where cooperative bands of sheep have combined a large number of permits into one enterprise. This is not where several individuals actually operating farms or ranches combine their sheep for more economical operation. The type of operating unit referred to is where a large number of small permits, some as small as 9 sheep, have been combined into one unit. For example, there is one operation that includes about 40 permits ranging in size from 9 to 625 sheep. Originally, this was a true cooperative band of sheep but now has evolved into a business operation much like a corporation where the stockholders are holders of grazing permits. The individuals holding these forest permits own farm or ranch property, although many of them do not operate this land. Furthermore, the sheep owned by these permittees do not use these farms or ranches at any season of the year. They are grazed on the west desert of Utah for six months in the winter, trailing to and from this range, and are on owned and leased range during the spring months. This operation handles around 3,000 sheep.

In some instances an operator with a permit for less than one band of sheep will lease one or more forest permits and also sheep sufficient to make his set-up one full band in size, thereby increasing the efficiency. Frequently the permit or permits leased belong to an estate that is in the process of liquidation and the leasing of the permit is a preliminary to the transfer and combining of the permits with his own.

Briefly summarized, the foregoing information shows the following:

1. Acreage of land controlled is not a good criterion for classifying livestock operations as to size in the public range land areas.
2. In establishing livestock size classes, it is essential that each class represent a farm or ranch organization common in the area.
3. The number of livestock permitted on the national forest is not a good indication of the size of the operating unit.5/

5/ Other area economic studies in western range areas have also found this to be true. In the economic study under consideration it has been found that the number of sheep licensed on the Taylor Grazing Districts usually represent the number of sheep operated and the number of cattle licensed is frequently the number of cattle owned. This situation is probably due to the fact that the Grazing Service has not established maximum limits. Furthermore, the Grazing Service does not have the splitting up of permits among one operating unit because it has not set up protective or minimum limits.

4. In central Utah the number of forest permits does not indicate the number of operating units using the forest.

FOREST MANAGEMENT RESEARCH

FOREST FIRE PROTECTION

Allegheny

Control

Recently initiated by the Station, in cooperation with the State and the CCC, was a test of different types of firebreaks on the Lebanon Experimental Forest. The test will compare the effectiveness and costs of establishment and maintenance of disked shaded firebreaks with those of the burned shaded firebreaks, or safety strips, now used on State Forests in South Jersey.

Appalachian

Experiments with the "Frost Pocket". Work on the minature "frost-pocket" which was described in the October bi-monthly report, page 22, has been completed. The device was rebuilt and improved during October and since then temperatures have been recorded in the instrument which were 25 degrees F. lower than the air temperature just outside the frost pocket. The most surprising result was that the device worked almost as well in broad daylight as at night. Water would freeze in the radiating chamber at 1:00 or 2:00 p.m. on warm sunny days when the air temperature was 54 degrees F. Fuel moisture indicator sticks in the radiating chamber remained covered with frost all day even when the maximum air temperature reached 60 degrees F. The relative humidity in the frost pocket was more than twice as great as the relative humidity outside.

This apparatus duplicates in miniature that which occurs on a larger scale on the earth's surface. When it was found that the frost pocket worked even in daylight, it was suspected that on calm, cloudless days, the fuels on shaded north slopes could radiate their heat into space, and the resulting drop in temperature might cause the fuels to gain moisture from condensation or increased relative humidity, or at least cause them to conserve their moisture because of low vapor pressure. Recording thermometers were then installed on adjacent steep north and south slopes at equal elevations. Two thermometers were used on each slope, one to record the surface litter temperature (actually litter air space temperature)

and one to record air temperature five feet above the ground. Table I shows the maximum and minimum temperatures obtained for each thermometer during a 24-hour cloudless period on November 28-29.

Table I.

Thermometer Position	Maximum Deg. F.	Minimum Deg. F.
Litter (south)	97	18
Air (south)	51	30
Litter (north)	32	18
Air (north)	46	29

The results of Table I are in agreement with results obtained with the frost pocket, and from the temperatures found it can be shown that moisture will condense on the north slope fuels when the south slope relative humidity is as low as 50 percent. It had previously been assumed that north slopes make good fire breaks in late fall because they were not subject to the drying effect of sunlight. However, it appears that terrestrial radiation is equally if not more responsible for high moisture contents on north slopes since it may cause actual condensation of water on the fuels. This is indicated from the results of Table II, which gives the moisture content of the surface and also the total or complete fuel layers at 2:00 p.m. on November 29.

Moisture content in percent of oven dry weight

Table II

	Surface layer	Complete layer
South	10.8	47.0
North	38.0	161.0

Fire Damage Appraisal. A technical note on the new fire damage appraisal system, mentioned in previous reports, will be ready for publication in January. The new system will permit determination of damages immediately following a fire, and with a minimum of field examination. The table below shows the average damage in dollars per acre caused by the average fire in the Southern Appalachian Mountains by danger class, type, condition class, and degree of stocking. Knowing the fire danger class, an experienced man familiar with his district could estimate with reasonable accuracy and classify the burned area into type, condition class, and degree of stocking.

Average Damage in Dollars per Acre

Fire Danger	Class 2		Class 3		Class 4		Class 5	
Condition class	Sawlog	Under-sawlog	Sawlog	Under-sawlog	Sawlog	Under-sawlog	Sawlog	Under-sawlog
Stocking			Hardwood Types					
Good	0.30	0.55	0.84	1.40	2.20	3.38	5.02	7.27
Medium	0.34	0.45	0.92	1.16	2.36	2.81	5.27	6.06
Poor	0.40	0.41	1.01	1.05	2.49	2.54	5.46	5.51
Stocking			Pine-Hardwood Types					
Good	0.37	0.61	0.99	1.49	2.44	3.34	5.24	6.78
Medium	0.42	0.54	1.10	1.34	2.62	3.01	5.53	6.13
Poor	0.49	0.50	1.21	1.25	2.79	2.85	5.76	5.82
Stocking			Pine Types					
Good	0.24	0.35	0.68	0.90	1.81	2.19	4.22	4.83
Medium	0.28	0.34	0.75	0.88	1.95	2.16	4.47	4.78
Poor	0.32	0.33	0.84	0.86	2.09	2.13	4.68	4.73

Richard Feaster has just returned from a danger station inspection trip through the national forests of Region 7. Most of the 68 stations he inspected were in very good shape as to mechanical operation and efficiency of the observers.

Lake States

Since the Station has been made responsible for drafting the fire problem analysis for the whole of Region 9, a great deal of contact work has been necessary, especially in the Central States part of the territory where dependence must be placed largely on others for the essential information. This work was carried on by Mitchell in October, after which he participated in the discussion of fire problems at the Central States Investigative Meeting at Rolla, Missouri. In November he assisted the Regional Office in analyzing Mr. Headley's plan for rating burning conditions on a Nation-wide scale.

The problem analysis should be ready for submission in the very near future.

Northern Rocky Mountain

Field work on the first stage of the study of the distribution of fire danger factors with altitude, aspect, and time of day is now completed and plans are being made to start the second stage. During the five years 1935-39, the study was confined to

six stations which were paired on north and south slopes at different elevations on a single ridge, and to two stations on a valley bottom, one of which was fully exposed to sun and wind and one partly timbered, and all on the Priest River Experimental Forest. From these years of study certain principles were discovered which form the subject of U.S.D.A. circular 591, which is now in press.

During 1940 these principles of altitudinal distribution of fire danger were tested at three widely separated places in the region. Preliminary examination of the data, which are now compiled but not analyzed, indicates that the principles will be found to hold true at all three places.

Hayes has commenced the preparation of an article stressing the practical significance of altitudinal and diurnal fluctuations of fire danger on north and south slopes.

The second stage of the "altitude and aspect" study will be to investigate the variations of fire danger and its component factors along a transect of a mountain valley, following the general idea of Bates' "Transect of a Mountain Valley" but with more continuously recording instruments and with major emphasis on fire factors. A transect of Benton Creek Canyon on the Priest River Experimental Forest has been selected. The axis of Benton Creek and the ridges on either side of it are nearly true east-west where the transect crosses them in a north-south direction. Station sites along the transect are to be on true north and south slopes. A strip 100 yards wide and extending 0.83 of a mile from the crest of one ridge to the crest of the next will be cleared of timber to furnish open exposure for the instruments. It is hoped that paired measurements may be made within the cleared strip and under the adjacent timber but we do not have enough instruments at present to equip both as open-exposed and a sheltered series of stations. The clearing of the transect strip will be started with CCC labor this winter.

Pacific Northwest

As a member of its forest protection committee, Matthews prepared a recommendation on the standardization of fire reports for the consideration of the Washington State Forestry Conference of December 6, 1940. This recommendation called attention to the fact that the definitions of the causes of fires used on the fire reports of the States of Washington and Oregon do not correspond in many important details to the definitions in the new "Glossary of Terms Used in Forest Fire Control", which are now standard for the Forest Service. This leads to inaccuracies whenever State and national forest figures of fires by causes are added together and makes for confusion whenever causes of fires are discussed by

State and national forest men. There is also the important matter of the definition of a reportable fire. There appear to be other items on the reports that should be standardized. It may be that there are other States not now using the glossary definitions and that the subject of the definitions of causes and standardization of reports would be an important topic for discussion and action at a State Foresters' annual meeting.

Study of Adequate Fire Control on Non-Federal Land. The manuscript of the report on the first sample area, western Snohomish County, Washington, was reviewed by individuals representing a number of interested agencies, including the Division of Forestry of the State of Washington, Washington Forest Fire Association, West Coast Lumbermen's Association, and the Regional Forester's staff. The report will be processed at the Station and will be ready for distribution about January 1, 1941.

Fire records, cover maps, and other pertinent data bearing on the second sample area, the Clackamas-Marion unit in Oregon, have been assembled and are being analyzed. This unit contains a wide range of cover and land use conditions and fire problems since it includes some of the highly developed agricultural lands of the Willamette Valley, and their small areas of woodlands, a considerable acreage of predominantly forest land with intermingled farms, and cut-over and virgin forest lands with very few inhabitants. It is planned to release summaries of fire occurrence, protection status, and cover types as related to land use districts in this unit about the first of the year.

Southern

Behavior

New copies of the Longleaf-Slash Pine Fire-Danger Meter were prepared. There were changes in the moisture scales. The "cured" scale was revised in accordance with a new correlation between moisture content of the basswood indicator and actual fuel moisture. The other important change was the recalibration of the "Transition" scale to give readings midway between those obtained by use of the "green" and of the "cured" scales.

Effects

Re-examinations were made on the Dry Prong Tract for the study of the relationship of age of rough to the establishment of longleaf pine reproduction, and for the study of the silvicultural use of fire in bringing a stand of longleaf pine from germination to initiation of height growth.

Work on a progress report for the Roberts Plots was nearly completed. A study of the growth for the period Nov. 1934 - Feb. 1940 indicates that in the last five years both diameter and height growth were greater on the burned plot than on the unburned plot, as shown in the following table:

Average Growth and Mortality, Nov. 1934 - Feb. 1940

Plot treatment	Species	Diameter (Inches)		Height (Feet)		Mortality
		All stems	Best 200 per acre	All stems	Best 200 per acre	No. stems per acre
Annually burned	Longleaf (only species)	0.86	1.63	10.36	11.41	324
Unburned	Longleaf	0.79	1.13	9.97	11.28	228
	All pines	0.81	1.17			

Since part of the apparent advantage on the burned plot is due to mortality in the smaller trees, it seems unlikely that the burned plot will soon overtake the unburned in average height. If, however, the present rates of diameter growth continue, it will be only 9 years before the average diameter of the best 200 longleaf pines per acre on the burned plot exceeds that for the unburned plot.

The average differences in favor of the unburned plot in February 1940, for longleaf pine only, were as follows:

Ave. diameter (Inches)		Ave. height (Feet)		No. stems per acre
All stems	Best 200	All stems	Best 200	
0.70	0.86	10.14	11.11	116

California

Equipment used in the collection, extraction, storage, and application of pollen in the breeding program of the Institute is quite elaborate and consists of many materials. To safeguard against contamination by pollen remaining in the equipment or present in the air, it is necessary to sterilize all equipment before it is used each time. The application of heat has proved to be effective but because rubber, glue, and cellulose compounds are affected by heat, the treatment should be as brief and at as low a temperature as possible without sacrificing results. Righter has learned, in tests carried out for him by E. J. Hodgkins, that a temperature of 80° C. for 15 hours will kill all pollen and effectively sterilize pollination equipment. Pollen of the following species was tested: Pinus aristata, P. caribaea, P. Coulteri, P. excelsa, P. Jeffreyi, P. Jeffreyi x Coulteri, P. Lambertiana, P. ponderosa, P. resinosa, P. sylvestris, P. taeda.

The first stage of the project dealing with correlation between vigor and growth hormone content of pines has been completed by Mirov. The results were summarized and discussed in a manuscript entitled, "Distribution of growth hormone in shoots of two species of pines," sent to the Journal of Forestry and accepted for publication. This work represents the first step in an attempt to correlate hereditary vigor with the concentration of growth hormone in forest trees. A suitable technique was developed for assay in pine trees of growth-hormone; and its concentration was determined in the terminal and whorl buds of the annual shoots, and also in the xylem and in the phloem of young pines. Further studies concerned with the project will deal with determining growth-hormone concentration in the cambium of mature pines. It is hoped that the results of these experiments can be applied in the future for selection of desirable specimens in forest nurseries and in natural stands.

Northeastern

Spruce Breeding. Three species of Picea were available for controlled breeding in the spring of 1940. The number of apparently normal seeds matured to controlled pollinations on spruce were as follows:

	No. of seeds
P. excelsa (♀)	
Self-pollination	845
Inter-specific cross-pollination	
X *canadensis* (♂)	2732
X *orientalis* (♂)	1550
P. orientalis (♀)	
Self-pollination	425
Inter-specific cross-pollination	
X *excelsa* (♂)	130
X *canadensis* (♂)	1180
P. canadensis (♀)	
Self-pollination	1950
Intra-specific cross-pollination	3220
Inter-specific cross-pollination	
X *excelsa* (♂)	4540
X *orientalis* (♂)	3102

Beech Breeding. *Fagus* species bloom at very irregular intervals. The results of the 1940 breeding, which was limited by the number of blooming trees, are as follows:

	No. of seeds
F. grandifolia (♀)	
Self-pollination	29
Intra-specific cross-pollination	27
Inter-specific cross-pollination	
X *sylvatica atropunicea* (♂)	39
X *sylvatica* (♂)	26
F. sylvatica atropunicea (♀)	
Self-pollination	25
Intra-specific cross-pollination	10
Inter-specific cross-pollination	
X *grandifolia* (♂)	18
X *sylvatica* (♂)	12

Birch Breeding. Breeding with *Betula* was continued on about the same scale as in previous years. Large numbers of seeds were matured to the following controlled pollinations:

Female parent		Male parent
B. papyrifera	X	B. lenta
" "	X	" lutea
" "	X	" nigra
" "	X	" populifolia
B. populifolia	X	B. papyrifera
" "	X	" lenta
" "	X	" nigra
" "	X	" lutea
B. Lutea	X	B. lenta
" "	X	" papyrifera
" "	X	" populifolia
B. lenta	X	B. papyrifera
" "	X	" lutea
" "	X	" populifolia

The number of seeds is not recorded (it runs to thousands) because members of this genus apparently produce parthenocarpic seeds (which are usually non-viable) without pollination.

Inter-generic crosses were made between species of Betula, Ostrya, and Carpinus. The crosses which produced seed are indicated below; it is expected that most of the seeds will be non-viable.

Inter-generic Crosses

B. papyrifera	X	Ostrya virginiana
" lutea	X	" "
" "	X	Carpinus caroliniana
" lenta	X	" "
" "	X	Ostrya virginiana

Physiology. The results of experiments dealing with the vegetative propagation of white pine from greenwood cuttings started during the summer of 1939 have indicated that this species can be rooted on an average of about 50 percent in outdoor propagating beds under optimum conditions. A number of factors were found to have a marked influence on the degree of rooting obtained.

(1) Cuttings from trees ranging from 5 to 40 years of age showed a varied response; those in the younger age groups rooted much more readily, with negative results for cutting from trees older than 15 years.

(2) Position on the tree from which greenwood cuttings are taken also markedly influences rooting. In tests involving seven different rooting types the greatest rooting response was

obtained with cuttings farthest removed from the terminal, i. e., the lateral segments of current season's growth on lateral branches in the lower portion of the tree. This is of practical importance because there are more potential cuttings of this latter type on a white pine tree than any other type. This position effect is probably the underlying relationship involved in reports that, in general, cuttings from the lower part of the tree root more readily than those from the upper part of the tree.

(3) Maximum rooting was obtained with a treatment of indolebutyric acid at a concentration of 25 mg./l. followed by dipping in auxin dust before planting in outdoor propagating beds covered with sash.

(4) A propagating bed covered with glass sash at night and having decomposed horse manure and straw under the rooting medium of a sand-peat mixture gave better results than the usual open type bed covered with burlap shade frames and containing only a 3:2 sand-peat mixture.

(5) There were some indications that individual white pine trees varied in their inherent rooting ability.

(6) The possibility of beneficial effects of the presence of fungi in the rooting medium was suggested by several recurring circumstances. In nearly all cases where rooting occurred the propagating medium was either heavily infected with fungi or had been used previously for coniferous stock and contained numerous partially decomposed needles. The production of auxins by the fungi may have been responsible in part for the observed effects.

Pacific Northwest

The plantations of hybrid poplars and of black cottonwoods on Lady Island were given their fall examination and it was a surprise to find very high mortality in the 1940 plantation that had occurred since the mid-June examination, while mortality in the 2-year plantation was slight. It is thought that the rooted plants had difficulty in surviving the summer drought in competition with a sod and rank weed growth, even though this is good cottonwood land, until their roots had had time to reach the moister subsoil.

Appalachian

Growth Plots in Profusion. The Station has a rare opportunity to discover by direct measurement how much trees grow over a wide variety of forest stands. Five or six years ago, cruises were being run of experimental forests and of other study areas in the southern mountain and piedmont sections of the Station's territory. Over 3,000 of the cruise plots were marked with stout, painted stakes. These plots are being recruised, and although no trees were tagged and the tally was made to the nearest inch only, there has been enough growth to show distinct changes in plot volumes. Dead trees were paint-blazed during the first cruise. Unpainted dead trees found in the cruise now being run are tallied as mortality for the interval between cruises. The remeasuring of the 500 plots at Bent Creek has been completed, and the job on the 1,300 plots on the Toccoa Experimental Forest is well along. Field work will be continued all winter.

Field-going Slide Rules. The first draft of a manuscript on "Circular Slide Rules for Solving Linear Equations" has been written. Slide rules, straight or circular, can be set up to solve any formula involving linear relationships only, between single-valued functions. Circular rules have the advantage of compactness; all slides are fastened together, and consequently circular rules are especially suited to field use. They can easily be made in quantity from stiff paper, and should help to take the curse off the use of complicated formulae in the field.

Deceiving Logarithms. A logarithmic formula, connecting volume of oak topwood with size of tree, was recently found to fit the data very well, provided the data were in logarithms. But the aggregate deviations of the volume tables were excessively high, and when actual volumes were plotted, the logarithmic curve avoided them, staying far below all except a few eccentric points. Such a curve, of course, passes near the geometric means rather than the arithmetic means, and the distribution of top volumes within tree-size classes is of a type with these two kinds of means far apart. Logarithms are tricky when aggregate deviations are to be made small. Other formulae, not involving logarithms, are being tried with the oak top volume data and are giving considerable promise.

Central States

Tree Studies

During October additional sets of tree measurements were transmitted by the Ohio Woodland Survey to the Central States Station as basis for local volume tables. These data included 120 measurements of yellow poplar from Holmes County, and 75 of beech, 75 of white oak, 76 of cottonwood, 75 of red oak, 75 of black walnut, and 88 of sycamore, all taken in Hamilton County, Ohio. During November additional sets of tree data were received. From Hamilton County, Ohio came 81 measurements of black cherry and 83 of white ash, and from Holmes County 96 of native white pine. Tables for both native white pine and native hemlock along the Mohican River bluffs in Knox, Holmes, and Coshocton Counties are being prepared.

Volume Tables

Unfortunately, the departure of Adman, the transfer of the WPA representative on the WPA computing project, Mr. Thurman E. Bercaw, and the reduction in size of the project all combined to disrupt the volume table work in the closing week of October and on through November. One table for yellow poplar in Hamilton County, Ohio was completed, and another for Holmes County, Ohio was well-advanced. Arrangements were made to have an increasing amount of the preliminary computing work done in the District or County Supervisor's offices.

Arrangements have been made to cooperate with the Shawnee National Forest and with the Ozark National Forest in the preparation of volume tables.

Converting Factors. Following the Investigative Meeting at Rolla, Mo. a decision was reached that in the future scaling for Stave-bolt Converting Factors will be more inclusive. Preliminary work was for "Bourbon" grade bolts. Scaling for "oils" or better will be used in the future. Because of personnel shifts on the two Missouri National Forests, the study is inactive for the present and near future.

Pacific Northwest

Growth of Even-Aged Spruce-Hemlock at Cascade Head. Computations of the 1940 remeasurements of 11 permanent sample plots in 89-year-old spruce-hemlock at Cascade Head were completed and a brief summary of results prepared for a Research Note. The results summarized in the following table further substantiate the

claims of high yields made for this type. In six seasons between measurements this stand added 16.8 cords or 10,500 board feet, Scribner rule, to its per-acre volume of live trees in spite of mortality from windfall and suppression that averaged 5.8 cords or 2,220 board feet, Scribner rule, per acre. The effective mean annual increment of marketable pulpwood made on this land discounted for existing utilization practices is estimated at 2.2 cords per acre.

Average Statistics for Eleven One-Acre Permanent Sample Plots in Even-Aged Spruce-Hemlock at Cascade Head Experimental Forest

Average of --	Spring 1935	Fall 1940	Change in six seasons
Total number of trees	212	203	-9
D.b.h., all trees, inches	19.1	19.9	+0.8
Total height, all trees, feet	127	133	+6
Volume of --			
All trees, cubic feet	21,090	22,530	+1,440
All trees, cords	245.2	262.0	+16.8
Trees 6.6" + d.b.h.,bd.ft.,Inter.	152,000	163,500	+11,500
Trees 11.6"+ d.b.h.,bd.ft.,Scrib.	119,200	129,700	+10,500
Mean annual increment in --			
Cubic feet	254	253	-1
Cords	2.95	2.94	-0.01
Board feet, International	1,831	1,837	+6
Board feet, Scribner	1,436	1,457	+21

Growth of Ponderosa Pine by Keen Tree Classes. The Keen system of classifying ponderosa pines has been in general use in this region for some time in timber cruising, making mortality estimates, and other studies use. However, the growth study made by Meyer a number of years ago is based on the seven classes recognized in the Dunning classification. It is very desirable that we be enabled to make growth predictions by the 16 classes of Keen's scheme that all phases of our pine stand analyses may be on the same basis. Mr. Keen's office of Forest Insect Investigations has core measurements of some 8,000 trees which that office has taken and classified. This affords an excellent opportunity to make, as a supplement to Meyer's earlier study, a comparative study of the growth of the 16 tree classes. A working plan has recently been prepared by Briegleb for such a study in which this office will cooperate with the office of Forest Insect Investigations.

Rocky Mountain

Stand Studies

Ponderosa Pine. In response to an urgent need for growth and yield information to be used in management plan revision, a preliminary study of growth of selectively cut stands of ponderosa pine on the Montezuma National Forest was conducted during June 1940. In all, 31 one-acre plots were established when field work was closed.

The analysis of the plot data was made by performing a multiple correlation in which gross yield in board feet was the dependent variable. The independent variables were reserve volume in board feet and number of years since cutting. All data were coded in logarithms so that curvilinear relationships might be avoided.

The multiple correlation coefficient obtained was 0.9605 with a corresponding coefficient of determination of 0.9226. The standard error of estimate was: ± 0.0805.

The calculated regression equation was:

$$X_1 = 0.9561\ X_2 + 0.0552\ X_3 + 0.2247$$

where:

X_1 = log. gross yield, X_2 = log. reserve volume,

X_3 = log. number of years since cutting.

Estimated yields when checked against the measured yields of the 31 plots gave an aggregate error 0.003 percent low, and an average percentage deviation of 13.8 percent.

A table of gross yields as computed with the regression equation is given below:

Yield of Selectively Cut Ponderosa Pine

Dove Creek Unit, Montezuma National Forest

Reserve volume	Number of years since cutting		
	15	25	35
Bd. Ft.			
1,000	1,438	1,480	1,507
2,000	2,791	2,871	2,924
3,000	4,112	4,231	4,309
4,000	5,415	5,571	5,674
5,000	6,702	6,895	7,023
6,000	7,978	8,207	8,360
7,000	9,245	9,510	9,687
8,000	10,505	10,805	11,010

Engelmann Spruce. A large portion of the field season was devoted to collecting field data for a growth and yield study of cut-over stands of Engelmann spruce in Colorado. As a preliminary step a large number of spruce cuttings of various ages were visited throughout the region to obtain a good cross-section of stand conditions in spruce cuttings.

In all, 42 one-acre plots were measured. Of these, 15 were permanent sample plots on which complete records from time of cutting were available. The other 27 were temporary plots on which growth data were obtained from increment cores.

Besides collecting growth and yield data, each plot was sampled with a 10 percent cruise by the stocked quadrat method to obtain information on the amount of reproduction and the proportion of spruce and fir with respect to stand conditions.

REGENERATION

Appalachian

Planting Specifications. Based on survival and growth of about 200 plots at the end of the third year after planting, these species and mixtures have been found best adapted to dolomitic soils (Fullerton and Clarksville) on old field sites in the Great Appalachian Valley in eastern Tennessee:

1. Shortleaf pine
2. Eastern white pine
3. Yellowpoplar
4. Black walnut
5. White ash
6. Shortleaf pine and yellowpoplar
7. White pine and yellowpoplar
8. Shortleaf pine and white pine
9. Yellowpoplar and black walnut

The following planting specifications, tentatively recommended for these or similar areas in the Appalachian Valley, will be refined, clarified, and adjusted as further results are available and recommendations for other soil series prepared. Mixtures should be by 9-tree alternate squares or checkerboard arrangement.

Shortleaf pine:--Will do well anywhere except in areas with dense briars, weeds, or where receiving overhead shade.

In general, it should be confined to the poorer sites with a southerly or south-westerly aspect and little vegetative competition, and on eroded northerly slopes or ridges.

White pine:--Will do well on all except the poorer sites or those with the heaviest vegetative cover. Should be planted on northerly, easterly or the better southerly aspects. In respect to site requirements this species occupies a position intermediate between shortleaf pine and yellowpoplar. A sandy, gravelly, or silty A horizon with a B horizon not heavier than a loamy clay is indicated. The A horizon should be at least 5, preferably 6 or 7, inches deep.

Yellowpoplar:--Should be confined to northerly or easterly aspects, "sinks" or pockets with a deep (over 12 inches) A horizon, and to well drained bottoms. The A horizon should be a silt loam or clay loam 7 inches or over in depth, loose and friable. The B horizon should not be heavier than a loamy clay in the lower part and a clay loam in the upper part. The B horizon should be well drained, aerated, and friable, although a slightly plastic consistency is permissible. The total depth of the A and B horizons (down to the C) should be at least 2 feet.

Yellowpoplar can be planted in dense briars, weeds, or under sassafras and poorly stocked stands. Under partial shade the soil requirements can be reduced slightly. On sites with very dense, tall briars or weeds, yellowpoplar is always to be preferred above other species unless the soil is water logged.

In thick broomsedge where there is evidence of rodents, avoid yellowpoplar planting, or at least pure plantations.

Black walnut:--Good growth of this species requires at least as good or better sites than yellowpoplar. It tolerates heavy competition very well although perhaps not quite so well as yellowpoplar. It should be confined to relatively small groups in "sinks," well drained bottoms, and on the better northerly aspects. This species has shown better growth on the loose shale than on the dolomitic soils. Avoid planting walnut in broomsedge where evidence of rodents is present.

White ash:--Should be planted only on the best walnut and yellowpoplar soils, as described above, and only in small amounts. Growth has been poor except on the best sites characterized by well aerated, deep soils with a good moisture supply.

Do not plant ash in thick broomsedge where evidence of rodents is abundant.

Shortleaf pine-yellowpoplar mixture:-- The growth of these species for the first 3 years is about equal on the best sites. This mixture should be planted on the best northerly or northeasterly sites where the vegetative cover is not composed of very dense briars or weeds. The soil characteristics should be the same as those given above for yellowpoplar. The mixture is well suited to good sites just out of cultivation.

White pine-yellowpoplar mixture:--This mixture should be compatible on fair to good sites on northerly or easterly aspects. The site should be intermediate between those suitable for yellowpoplar and shortleaf pine. Vegetative cover may be somewhat denser than for the shortleaf pine-yellowpoplar mixture. In general, the mixture should be used on the better white pine and poorer yellowpoplar sites as described above.

Shortleaf pine-white pine mixture:--Growth figures indicate this would be successful on good northerly or easterly aspects, i.e., essentially the same as for the shortleaf pine-yellowpoplar mixture. This mixture should be given preference to shortleaf pine-yellowpoplar, however, in borderline cases where there is a question of the fitness of the site for the yellowpoplar.

Yellowpoplar-black walnut mixture:--Confined to "sinks," well drained bottoms and the best northerly aspects. Can be best used in areas of deep, black soil with heavy vegetative cover. The mixture should be 2 to 1, i.e., 18 poplar to 9 walnut.

A "Pilot Plant" for Experimental Results. The Station has already made practical use of the planting specifications described above on a 2,800 acre tract of T.V.A. land containing 719 acres of plantable land in scattered old fields. A planting survey, based on the specifications, was made and 103 plantations located on a contour map. This is to serve as a proving ground or "pilot plant" for experimental results. Planting of the areas will be done this winter.

The acreage and number of plantations for each species and mixture is as follows:

Species	Area in Acres	No. of Plantations
Shortleaf pine	366	36
Eastern white pine	72	16
Yellowpoplar	72	15
Black walnut	10	3
White ash	4	2
Shortleaf pine-yellowpoplar mixture	71	9
White pine-yellowpoplar mixture	47	10
Shortleaf pine-white pine mixture	56	8
Yellowpoplar-black walnut mixture	21	4
Totals	719	103

Central States

Chapman spent the major part of October and November in field work involving measurements of planted stands in Illinois and Ohio. These experimental plantings were designed to test the success of different grades of planting stock on varying soil types and sites. Further work was planned in Missouri as the result of a conference with Collins, of the Mark Twain Forest.

Nursery. Compilation and analysis of data from three years nursery soil investigations is nearing completion. Some outstanding observations are:

1. Damping off drainage seems to be an indirect effect of soil pH which, when high, results in rapid nitrification. Too much nitrogen favors fungi which attack the tender seedling stems. If this is true it has an important implication as regards cover crops and fertilizing.

2. Phosphorus is often the limiting element in nursery soils. No amount of it so far applied has had direct injurious effects. There is evidence, however, to indicate that lush growth of seedlings too late in the fall induced by too much phosphorus increases winter killing.

3. Potassium applications have so far resulted in little or no growth or survival effects.

4. Slowly available nitrogenous material such as soybean meal applied before seeding pines is equally as injurious as soluble nitrates.

5. The rarer elements, copper, zinc, manganese and boron gave no beneficial results on our soils.

6. Applications of acid peat definitely increased early survival.

7. Lack of mycorrhizae may often be misinterpreted as nutritional difficulties.

Lake States

New Developments in Seed-Testing Technique. Practically all of the germination tests conducted at the Station in the past have been run at a range of temperatures which approximate those occurring in nature in the summer months, namely 68-86°F. For the common Lake States conifers this seems satisfactory, but other

species have shown consistently poor germination at these temperatures. Accordingly, recent tests have been made using some of the more refractory species at temperature ranges of 50-77° and 41-50°F., which simulates that rather long period in the spring characterized by relatively cool nights and warm days. The use of these new temperatures has shown some rather striking results for some species. For instance, boxelder, which gave a germination of only 12 percent at a temperature range of 68-86° F., gave a germination of 67 percent at a temperature range of 50-77°. Wild plum, which gave a germination of only 13 percent at 68-86° and 26 percent at 50-77°, showed 86 percent germination at the 50° temperature. Results with other species have been equally startling and interesting.

Northern Rocky Mountain

Poisoning For Rodent Control in Direct Seeding. A procedure for rodent control in direct seeding operations as recommended by the Wildlife Research Laboratory of the Fish and Wildlife Service consists of two operations. First, the area to be seeded is baited one week before sowing with hulled sunflower seed treated with thallium sulfate. Second, the seed to be sown is coated with a poisonous mixture containing strychnine alkaloid as the active ingredient. Preliminary tests 1/ with these two poisons were very successful.

To determine whether or not seeding costs can be reduced by eliminating one of the poisoning treatments, three test areas of 10 acres each were sown in the fall of 1939. These three areas are on north-facing slopes in the Kalispell Creek drainage in the Kaniksu National Forest and were selected for uniformity of site. All of the areas were severely burned in August 1939 by a single fire which consumed the entire duff layer. Seeds of western white pine were sown on the three areas in spots about 8 feet apart with approximately 25 seeds per spot. On each area 9 sample plots of 25 seed spots each were staked out. Beside each sample plot a check plot of 25 screened spots was sown with exactly 25 seeds per spot.

Each of the three areas had a different poisoning treatment. The first area had only the poisonous coating on the white pine seeds sown there. The second had both the thallium-treated bait and the poisonous coating on the seeds. The third had only the thallium-treated bait.

1/ Schopmeyer, C. S. Successful forestation by direct seeding using poisons for rodent control. Research Note No. 1, Northern Rocky Mountain Forest & Range Experiment Station, Missoula, Montana. January 1940. Mimeog.

A good criterion of the effectiveness of the various poisoning treatments is the stocking percentage; that is, the number of spots with one or more seedlings expressed as a percentage of the total number of spots sown. These percentages are listed in table 1 for both screened and unscreened spots on each of the three areas. Since stocking in screened spots differed somewhat between areas, it appears that the sites were not uniform with respect to the factors affecting germination. The differences in stocking between screened and unscreened spots, however, gives the desired comparisons. These differences represent the differences between perfect rodent control as obtained under screens and those obtained with the use of the three poisoning methods.

Table 1.--Stocking percentages after completion of germination in comparison of rodent control methods

Rodent control method	Stocking percentage		
	Screened Spots	Unscreened Spots	Difference
Seeds coated with poison	94.7	39.6	55.1
Area baited and seeds coated with poison	88.4	71.1	17.3
Area baited	96.0	77.8	18.2

The results show that where the poisonous coating on seeds was used alone the loss in spots caused by rodent depredations was three times greater than where the other two methods were used. The results also show that on the area where only the poisoned bait was used the loss was practically the same as on the area where both the poisonous coating and the poisoned bait were used.

This test indicates that the poisonous coating on the seeds does not add much, if anything, to the protection from rodents afforded by the poisoned bait. This single test obviously cannot be used as a basis for a definite conclusion. If additional tests consistently give the same result, a saving of approximately $1 per acre could be made in direct seeding operations by eliminating the poisonous coating on the seed to be sown.

Allegheny

Harvest Cuttings.

Preliminary results of studies of 120-year-old second growth stands partially cut in the past indicate that removal of dominant black cherry stems at 80 years will release adjacent sugar maple and produce a desirable mixture of high volume and quality, which may again be heavily cut in 45 years. Lighter cuttings at shorter intervals, such as 20 or even 10 years, are indicated to be better practice and will yield a higher volume of sawtimber and products through the salvage of natural mortality.

Stand Improvement.

Evidence that light thinnings, removing chiefly the poorly formed dominant black cherry 11 inches d. b. h. and larger, are silviculturally more desirable and commercially cheaper than cutting all trees down to a 5" d. b. h. limit, was afforded by a study of pulpwood converting costs on lands of the Armstrong Forest Company, Johnsonburg, Pennsylvania.

Appalachian

Biltmore Thinnings. Results of the thinning experiments in the Biltmore Estate plantations have been compiled for the period 1916-1936. These experiments were started in 1916 in stands which were then from 17 to 20 years old and most of which were very dense as the result of planting at the rate of from 3,000 to 5,000 per acre. Three of the plots have been thinned four times, one three times, the intervals between thinnings being 5, 7, and 7 growing seasons. The first two thinnings were heavy, in one instance extremely so. Two of the plot groups (thinned plot and unthinned control) are in pure white pine, one in mixed shortleaf and white pine, and one in sugar maple and white pine. The results in growth rate and salvage are briefly as follows.

The thinned white pine in the "Old Orchard" plantation has made a net growth for the 19-year period amounting to 131 cubic feet per acre per year, and the material salvaged has averaged 112 cubic feet per year, so that the annual total production per acre has been at the rate of 243 cubic feet. With site conditions comparable to those of the thinned stand, the unthinned control has grown at an average of 99 cubic feet per year. The difference of 144 cubic feet constitutes an advantage of about 1.6 cords per year, total production, in favor of the thinned stand. The growing stock of the latter, in 1936, was considerably greater than that of

the control; in trees 8" d.b.h. and over its volume per acre was 2,262 cubic feet as compared with 1,580 cubic feet in the unthinned stand.

The white pine of the "Apiary" plantation does not show up as well. The growing stock of the thinned stand was materially lowered in 1922 by unauthorized cutting. Its annual growth per acre during the 19-year period has averaged 150 cubic feet, compared with 162 cubic feet for the control. When the large volume of material removed is added in, however, the mean annual total production of the thinned plot was 305 cubic feet. The effect of excessive thinning is evident in the difference between the growing stock volumes of the thinned and unthinned plots. In trees 8" and over, d.b.h., the volume per acre of the unthinned stand in 1936 was 5,721 cubic feet, or 49 percent greater than that of the thinned stand.

In the mixed shortleaf and white pine of the "Ferry Farm" plantation, one of the objects of thinning was to favor the white pine which, in 1916, was not doing as well as the shortleaf. While the basal area of the white pine in the thinned stand has increased from 12 percent in 1916 to 22 percent in 1936, the effort was only moderately successful; in the control plot the basal area of the white pine also increased during the same period--from 25 to 37 percent of the total basal area. In both plots shortleaf pine predominates.

In this experiment the total basal area per acre of the control plot was the same in 1936 as in 1916. The thinned plot, however, made an annual growth of 4.5 square feet of basal area per acre, while the total salvage averaged 6.1 square feet, giving a total annual production measured by 10.6 square feet. The thinned stand also showed a decided advantage over the unthinned in the proportion of large trees it contained in 1936; in the thinned stand 25 percent of the basal area was in trees 8" d.b.h. and over, as compared with only 10 percent in the unthinned stand.

Thinning in the mixed sugar maple and white pine of the "Apiary" plantation has been directed toward converting the stand to pure sugar maple, even though the white pine was recognized as the superior volume producer. Removal of the last of the pine in 1928 left the thinned stand with a growing stock much smaller than that of the control, smaller in maple as well as in pine; but the growth of the sugar maple in the thinned stand (not including the material removed in thinning) has been at the rate of 2.18 square feet of basal area per acre per year as compared with 1.80 square feet in the unthinned control. The control contains no maple as large as 8" d.b.h., while 12 percent of the basal area of the thinned stand is made up of maples 8" and larger.

In all the experiments except the "Apiary" white pine thinning, therefore, the advantage of thinning in increasing the proportion of the stand in the larger size classes has been clearly demonstrated.

An incidental result of this study was the quantitative expression of relations between growth percent of individual white pine trees and their crown ratios and basal areas, whereby the growth percent may be estimated with some degree of assurance if the other two values are known. The method may be useful as an aid in choosing between trees to be cut or left.

Acorn Production. For studying the factors influencing seed crops, the periodicity of seed years, the amount and viability of seed production by various classes and types of trees, and the effect of biotic factors on seed crops, 4-year records on the production of acorns by five species of oak are now available. Observations were made at approximately 10-day intervals during the seed production season for 210 trees on the Bent Creek and Toccoa Experimental Forests.

The analysis shows strikingly that only a small percentage of the well-developed acorns produced during the fall of the year is available for germination in the spring. For each 1,000 acorns produced during the average year, only 81 will eventually germinate, and it is certain that a large percentage of these will fail to survive. The records show that for the average of the five species, only trees 20 inches or larger in diameter will produce 1,000 well-developed acorns during the average year.

Several factors contribute to the reduction of the number of acorns between the period of production and the period of germination. While the acorns are still on the tree approximately 20 percent are damaged by rodents; an additional 22 percent are damaged by weevils, and due to a number of causes, at least 30 percent of the remaining acorns are not viable. After the acorns reach the ground many are consumed by rodents and deer, the amount depending on the game population. On the Bent Creek Experimental Forest, where the game population is high, there have been several years when nearly all acorns were consumed.

The following table summarizes the production of acorns and the reduction by several agencies, excluding the abnormal consumption of acorns by deer at the Bent Creek Experimental Forest.

Species	Annual production of acorns for 20-inch tree	Acorns on the tree			Available for germination on the ground
		Damaged by rodents	Damaged by insects	Otherwise not viable	
	Number	Percent	Percent	Percent	Percent
White oak	950	17	36	23	1.8
Chestnut oak	500	14	30	15	6.0
No. red oak	1,250	20	13	30	2.2
Black oak	1,300	34	17	52	1.6
Scarlet oak	2,700	15	22	25	23.6
Average	---	20	22	30	8.1

A number of interesting points are shown in the table. (1) Scarlet oak, the least desirable of the oaks, produces many more acorns than the other oak species, and a greater percentage is available for germination. Excluding scarlet oak, only 26 acorns would be available for germination per 1,000 produced, instead of the average of 81. (2) Apparently squirrels and other rodents prefer black oak acorns to those of other species. (3) Weevils seem to prefer acorns of the white oak group.

California

Sustained Yield at Blacks Mountain. The net volume logged from the experimental forest this season was 2,413 M B.M. of pine and 24 M B.M. of white fir. Hopes of continuing logging through November were blasted on November 3 when 24 inches of snow covered the logging area. The area salvage-logged during the season amounted to 670 acres, which brings the total area so logged since the fall of 1937 to 1750 acres. This represents about one-fourth of the area to be salvage-logged. Establishment of the third block of methods-of-cutting plots was completed, except for the logging of two of the six plots. These will be logged during the first part of next season. The total area in plots is now approximately 480 acres, of which 90 acres are in control plots.

Preliminary summaries from the first two blocks of plots show the following results with respect to logging damage and soil disturbance.

Method of cutting treatment	Volume cut	Area stocked[1]	Area not stocked but stockable[2]	Area in skid trails	Poles[3] destroyed
	Percent	Percent	Percent	Percent	Percent
None	0	56	33	-	-
Salvage-sanitation	17	50	38	18	4.4
Modified Forest Service	55	44	49	40	10.3
Standard Forest Service	78	40	55	61	15.1

1/ One or more seedlings or saplings per milliacre
2/ Soil does not appear to be utilized by tree growth, is not covered by shrubs, and reproduction is not excluded by rock, slash, or logs.
3/ Trees 3.6 to 11.5 inches in diameter

Since the study started in 1938 there have been no seed crops, so that the seed production capacity of the reserve under each system of cutting has not yet been measured. Seed crops will be estimated by sampling, using 800 30- by 30-inch seed traps.

Under heavy cutting, as compared to light, there is more area in need of stocking, much more area where seed bed conditions are favorable, but, it is safe to assume, much less seed available.

On the logging operation a change was made in the truck loader which released a tractor, reduced damage to the trucks and increased the safety of operation without materially reducing the mobility of the unit. The Le Tourneau crane was detached from the tractor and mounted on a sled so that the crane wheels support the front end of the sled. A double drum winch (formerly used to load railroad cars) was mounted at the back of the sled on cribbing high enough to afford the operator a clear view. One drum carries the loading line, the second drum is used to raise and lower the crane boom. The movable boom permits lifting the logs onto the truck instead of dragging them on, thus reducing truck damage, damage to the crane boom and the possibility of loading hooks pulling out. The unit can be readily leveled for side hill operation by cribbing under the sled. No guys are required although a snubbing line is attached to the peak of the boom to prevent raising the boom too far. Moving the loader is done simply by picking up the rear end of the sled under an arch and travelling with the front end riding on the crane wheels.

Central States

Silvics

The first draft of a report on the composition and mortality in the blackjack oak stands on the Missouri National Forests has been prepared.

The second year measurements of height growth and mortality of pine seedlings on plots receiving different types of seedbed treatment and release were made in November. The effect of seedbed treatment is not very pronounced, but the continued beneficial effect of release is very conspicuous.

A report on the "Height-growth Periods of Oak and Pine Reproduction in the Missouri Ozarks" was completed and submitted for publication in the Journal of Forestry. The height-growth of the oak was completed in 19 days, and 90 percent of it took place in the 11-day period from April 27 to May 7. Height-growth of pine continued throughout the season, and reached its maximum rate about May 20, more than a week after height-growth of oaks had ceased.

Timber marking on a tract of 225 acres within the Sylamore Experimental Forest was initiated during early October in preparation for a logging and milling study in which the Forest Products Laboratory, Region 8, and the Ozark National Forest are cooperating with the Central States Forest Experiment Station. The area was divided for purposes of the study into three subcompartments containing predominately oak, oak-pine, and pine. Over 960 shortleaf pine, black, northern and southern red and post oak with a total volume of 200,000 ft. B.M. of pine, and 30,000 ft. B.M. of hardwoods were marked and described as to size, tree condition, reason for marking, and merchantability rating. The area is being logged in connection with a going timber sale by an operator using tractors and winches to bunch the logs at the foot of precipitous rocky bluffs and raising them with cable and hoist onto trucks for hauling to the mill. All logging roads follow ridges and saddles, the snaking distance being in many instances as great as 600 feet. A total of 700 trees have been felled thus far, and measurements taken on approximately 1,000 logs. Data recorded after the trees have been cut include measurements for Girard's form-class volume tables, utilized height, merchantable height, log grade, and gross and net log scale. The logs are number stamped and 400 have thus far been mill graded, and a lumber and timber tally recorded. Cutting, skidding, leading, and hauling time are being kept for each subcompartment and logs are being timed through the mill. The field work is being carried on by the forest management staff of the Station, a principal lumber inspector from the Forest Products Laboratory, two Junior Foresters from Region 8, U. S. Forest Service, and C.C.C. enrollees.

Lake States

Commercial Thinnings for Pulpwood in Jack Pine. The necessity of thinning three 31-year-old jack pine plots on the Chippewa Forest in order to clean up storm damage brought out some interesting possibilities. From each plot a commercial cut of about 4 cords of pulpwood was removed. Since the plots had been previously thinned in 1929 to varying degrees, the number of stems per acre and average diameter varied considerably. Accordingly, different methods of marking were necessary. One plot having a dense stand (1,263 trees per acre) and a small average diameter had to be thinned from above in order to get merchantable pulpwood. Another plot with 1,104 stems per acre had a slightly larger average diameter so that thinning was both from above and below. The third plot had only 568 trees per acre but these were of relatively large size; consequently thinning was from below.

The first plot can probably be thinned again for small pulpwood in 10 years; the second for large pulpwood in about the same period; whereas the third plot will probably not be ready for another thinning until 15 years have elapsed, but at that time pulpwood as well as more valuable products such as mine timbers should be available.

These thinnings bring out numerous possibilities for handling young stands of jack pine of different densities which will be tried out on the Cutfoot Experimental Forest. Since the commercial feasibility of producing pulpwood through thinnings is now increasing rapidly, some expansion in thinning experiments should be possible at a fairly early date.

Influence of Slash on Black Spruce Reproduction. Observations during the past several years on cutting areas have indicated that slash may have a considerable bearing on black spruce regeneration. Consequently, some slash-disposal plots were established in 1938 in cooperation with the Superior National Forest. Although these were not scheduled for examination until 1941, Ranger Herman Olson was so impressed by the changed appearance of the plots that he took time this fall to make preliminary counts, the results of which are shown in the following tabulation.

Slash-disposal method	Number of seedlings present, per acre					
	Spruce		Balsam		Cedar	
	1938	1940	1938	1940	1938	1940
No disposal	0	0	1,417	2,833	167	0
Lop and scatter	71	848	1,000	1,642	1,571	1,285
Pile and burn	0	2,165	3,416	3,166	1,167	1,317
Pile	0	3,313	2,439	1,938	1,375	1,000

Although the sample counted was not large enough to warrant sweeping conclusions, the table indicates pretty clearly that getting rid of the slash by piling and burning or simply by piling it has materially increased the proportion of spruce in the reproduction.

Recruise of Cutfoot Experimental Forest. Because of the extensive damage by glaze to the Cutfoot Experimental Forest, a new inventory of the tract has become necessary in order to reassess what timber remains for management. The line-plot method of cruising is being used. All plot centers are being marked with creosoted stakes. In addition, the merchantable trees are being diagrammed on map forms. These semi-permanent plots will be highly useful in determining future growth and mortality without the necessity of maintaining painted numbers on plot trees. They should also serve as the sample plot record for any cuttings or stand-improvement measures that are instigated. The field work for the new inventory is progressing rapidly and should soon be completed due to the material cooperation furnished by the Chippewa National Forest.

Northeastern

In the summer of 1937 an experiment was initiated at Gale River Experimental Forest in northern New Hampshire to secure information on different phases of partial cutting in second-growth spruce-fir stands. A sale was made to a private operator involving about 90 acres and removal of 507 cords of pulpwood. The operator agreed to cut only marked trees, but was not restricted in the choice of the logging methods. In addition to this area, the operator purchased the timber on an adjoining 5 acres from a private owner, which yielded 58 cords of pulpwood through a clear-cut operation.

A record was kept of the logging costs on both operations by the experimental forest personnel in cooperation with the operator. A detailed study was made of the skidding costs, as the most debatable phase of logging in connection with partial cutting practice.

The larger part of the partial cutting area was cut over during the peeling season, and the logs were skidded in late summer. The rest of the partial cutting area involving 97 cords and the clear-cut area were cut over for rough pulpwood.

The skidding costs on the peeled pulpwood area proved to be considerably higher than those on the rough pulpwood operation due mostly to the fact that the operation was conducted on a day-

wage basis. Wages were $3.00 a day; team hire - $2.50 for one horse, $5.00 for two horses. The rough pulpwood skidding operation was sub-contracted on a per cord basis, and the same two horses and men were engaged on partial and clear-cutting areas.

The skidding costs on the partial cutting area averaged $1.10 per cord as opposed to $.75 on the clear-cut area. The difference in the skidding costs, however, was not as great as may appear from these figures. The clear-cut area was located along a road and the skidding distances were much shorter than in the partial cutting area. When this factor was taken into account using multiple correlation equations (skidding time as dependent of distance and d.b.h. of the average tree in a load), the difference in favor of clear cutting was only $.07.

Other operating costs on the clear-cutting area were somewhat higher than on the partial cutting area, due to the smaller diameter of the average tree cut. The total actual logging costs were $3.85 on the partial cutting area and $3.75 on the clear-cut area. Placing the two units on a comparable operating basis as to distance the operating cost per cord will be slightly in favor of partial cutting.

Northern Rocky Mountain

Two Timber Management Schools. Two white pine timber management schools were held on the Deception Creek Experimental Forest during early October. The first, from October 2 to 4, was held for technical personnel engaged in blister rust control and was attended by 35 members of the Forest Service and Blister Rust Control organizations. The meeting was given over to study and consideration of white pine silviculture, especially the establishment and development of western white pine as related to blister rust control. Daily field trips on the experimental forest and to nearby cutover areas on the Coeur d'Alene Forest gave visual demonstration of silvicultural practice and results.

The second meeting, conducted by the Region One division of timber management from October 7 to 11, was attended by approximately 40 Forest Service personnel concerned with timber management on the white pine forests. Almost the entire time of the meeting was spent in the field, part of the time on the experimental forest and the remainder on cutting areas of the Coeur d' Alene and Kaniksu National Forests. Marking and cutting practices, slash disposal, and sanitation methods were observed and discussed. Participants in the meeting agreed that present white pine silvicultural practices were fundamentally sound; only minor revisions were suggested.

Pacific Northwest

Douglas-Fir. Nine years of seed-fall records (from seed traps) under an old-growth Douglas-fir stand having a mixture of hemlock, redcedar, and balsam firs, showed an average annual fall of over 2 million seeds or approximately 10 pounds. Adjacent cut-over land for distances up to 1,000 feet from the timber edge had an average annual fall of a little over one pound. This area, clear cut about 10 years ago, is now fully stocked with reproduction most of which is Douglas-fir. Four years' record of a young growth (100 years) stand of Douglas-fir indicates that its seed fall is about a quarter that of the old growth.

The practically complete failure of seed crop for Douglas-fir and its associates this season makes inevitable a lean year in 1941 for natural regeneration. A cone crop failure of any one species is not uncommon but it is seldom that all species have so little seed simultaneously as they did this year.

Stand Improvement.

A pruning time study was made by Kachin in October, involving 35-foot pruning in 46-year-old Douglas-fir on the Aubrey Mountain pruning project, Willamette National Forest, and it is now in the final stages of compilation.

Compilation of data on two series of stand improvement plots at Wind River, remeasured in 1939, was completed and the report written. The Martha Creek series of thinned plots established in 1934 in 24-year-old Douglas-fir exhibited a marked acceleration of growth after thinning, while the Lookout Mountain series established in 1934 in 31-year-old Douglas-fir and heavily hit by the sleet storm of the same winter, while recovering is still showing the effects of this setback.

The third annual examination of Wind River P.S.P. 21, established in 1937 to test different severities of live crown pruning in small pole Douglas-fir, has shed much light on the possible unfavorable effects of indiscriminate live crown pruning. Retarded growth, large number of epicormic branches, and a severe sunscald injury are quite likely to occur if more than one-quarter of live crown is removed. Thus far the plot shows that 72 percent of the trees on which three-quarters of the live crown was removed have developed epicormic branches and that 24 percent of these trees were badly sunscalded.

Southwestern

A New Tool for Poisoning Ponderosa Pine. The chief item of cost in the poisoning of undesirable trees, as it has been done on the Fort Valley Experimental Forest, has been the time required to bore holes in the bole. In order to reduce this cost the Southern Forest Experiment Station has developed a tool (Bimonthly Report, Feb. 1, 1940) to make the holes by driving a sharpened steel tube into the wood. The tube is welded to the back of a single-bitted ax. One stroke with the ax makes a hole over an inch deep. The first core remains in the tube but the next one forces it out.

The original tool provides for ejection of the cores through a slot in the side of the tube. As modified for use on ponderosa pine, the cores exit through an angular groove cut into the back of the ax head. The tube is 2 inches long, 3/4 inch outside diameter, and 5/8 inch inside diameter. Both ends are open, one to receive the cores when driven into the wood, and the other to permit them to pass out into the groove in the ax head. The cutting end of the tube is honed smooth and sharp.

Since this instrument makes holes less than half the depth of those made by brace and bit, it is advisable on large trees to use the ax blade first to remove a portion of the outer bark. The added depth is necessary since any portion of the hole walled by bark will not hold liquid. Obviously, more holes must be made than have been necessary with brace and bit, in order to hold an equal amount of poison. The larger number of holes automatically affords better distribution of the poison in the tree because it diffuses only slightly in a lateral direction. The shallower holes also retain the poison near the cambium.

Following the second cutting of the Wing Mountain Sample Plot, Knutson-Vandenburg funds have been used in improving the residual stand. Trees of poor form which were competing with valuable ones, or were dominating reproduction, and especially those heavily infected with mistletoe were eliminated. On June 24, 25, and 26, 1940, two men poisoned 297 of these trees scattered over approximately 400 acres. They ranged from 5 to 27 inches in diameter. Spacing of the holes ranged from 3 to 6 inches depending on tree diameter and crown size.

An examination of 251 of these trees on August 17 revealed that 70 percent of them were dead, and that an additional 18 percent had lost 80 percent or more of their crowns. This 18 percent is expected to die before the end of the 1941 growing season. The trees which had not died at the time of the examination were mostly very large-crowned. It appears that size and form of crown may be more important than diameter in determining the number of holes required.

The new method of making the holes is much easier and faster than the brace and bit method, regardless of the fact that more holes are necessary. No difficulty is experienced in driving the tube full 2 inches into the wood. Considering the high proportion of large-crowned and otherwise abnormal trees, the results are satisfactory.

Salvage Cutting. An 80-acre tract of virgin ponderosa pine in the Fort Valley Experimental Forest was logged in October according to a method of marking suggested by the R-3 Division of Timber Management. In a stand of about 12,000 board feet per acre, 4,551 feet per acre were removed, including only distinctly declining trees. The defect proved to be 48.4 percent, and was due mainly to heart rot and lightning damage. The stumpage price was $3.47 per M, of which $1 per M was placed in a K-V deposit for stand betterment.

Since all the trees have been measured periodically during the past 15 years, future measurements should give an interesting record. Presumably, the high mortality of the past will be halted, at least temporarily. Since large groups were virtually undisturbed, no appreciable response in diameter growth is anticipated. Appearance of the stand after cutting suggests the advisability of a heavier cut within 10 years.

FOREST PRODUCTS

FOREST PRODUCTS STATISTICS

Northern Rocky Mountain

Wholesale Lumber Prices. The latest lumber prices (October 1940) compiled by the Division of Forest Products appear below, as well as some previous prices which are presented for comparison.

Average Wholesale Lumber Selling Prices[1/]
(N.E. Washington, Idaho, Montana)

	Annual 1939	July-Sept. 1940	October 1940
Idaho white pine	30.36	32.26	34.60
Ponderosa pine	24.32	25.93	26.76
Larch and Douglas-fir	18.93	20.23	22.31
White fir	15.72	18.93	20.23
Engelmann spruce	20.01	22.02	24.33
Western redcedar	24.12	23.25	27.88

1/Prices include commissions and discounts.

California

Wood in Aircraft. In company with a representative of the Forest Products Laboratory, Ericksen visited a number of aircraft manufacturing plants in southern California to learn the status of wood in aircraft construction and trends and problems in design. While no wood combat planes are in production at present a number of aircraft engineers and designers are enthusiastic as to the possibilities of wood in laminated and plywood form.

Smoking Pipe Burls. An interest in domestic sources for burls for smoking pipes is becoming evident, comparable to the interest shown at the time of the earlier great war. In both cases the interest is apparently due to restrictions on the supply of briar from Europe.

Several inquiries have been received from eastern pipe manufacturers and dealers. A representative of one large manufacturer recently made a personal survey of the situation in California and discussed with the Station staff questions involving quality of burls of different species and sources of material.

Second Growth Ponderosa Pine Mill Study. Field work on a second-growth ponderosa pine woods and mill study was carried out in October by Garland, in cooperation with the Diamond Match Company at its Sterling City mill, to determine the value of lumber from trees of different diameters when manufactured into standard items under good mill conditions. The dry grade will be taken after air drying next spring. The Products Division cooperated with Prof. Cockrell of the University of California Department of Forestry in securing discs from a number of the study trees for use in a study of the physical properties of wood of second-growth ponderosa pine.

Central States

Jaxon Timber Harvester. This machine, which consists of a portable sawmill mounted on a wide-beamed trailer with folding carriage track, and powered with two separate motors, was scheduled for demonstration at the annual meeting of the Central States Section on October 18-19. Unfortunately, while the owner was towing it overland from Wisconsin, the Illinois highway police impounded it and forbade its passage over state highways because of width. A harvester is now in Summit County, Ohio operating on Ohio hardwoods, and is available for observation.

Northern Rocky Mountain

Western Larch Plywood. Lumbermen of the region are much interested in the plywood made at the Madison Forest Products Laboratory from western larch. Most of them have now seen samples of the product and at a meeting at Moscow, which several lumbermen attended, Rapraeger talked on the subject.

Pacific Northwest

General. Lodewick presented a paper entitled "Hemlock: Past, Present and Future" before the Pacific Logging Congress in Victoria, B. C., on October 4. The same paper was read by request before the Puget Sound Section, S.A.F., in Seattle on November 1. The West Coast Lumberman and The Timberman both published the article in their October issues.

Mr. T. R. C. Wilson of the Forest Products Laboratory was a recent visitor to this region investigating the use of spruce in airplane construction. Several mills and fabricating plants were visited. It was the general opinion of operators that the quantity of spruce stock obtainable suitable for use as solid members is limited. However, by gluing up thin sawed stock and the use of glued up rotary cut veneer stock, the quantity of suitable beam material obtainable is unlimited. Such stock is now being used for wing beams in the smaller, and to some extent in the bomber type, training planes.

Mill Studies

Ponderosa Pine. The study conducted in cooperation with the O. and C. Land Grant Administration at the Ellingson Lumber Company in July was completed in October when the study lumber was pulled from the yard piles for shipment. The output of this company, according to the study sample of 478 M feet, consists of 21 percent Mldg. & Btr., 13 percent Shop (#1 and #2), 3 percent Dimension and 8/4 Common, and 64 percent Box. Of the study sample, 72 M feet was sugar pine, the remainder being ponderosa pine. One interesting and rather unexpected result was the low value of sugar pine logs. Logs of Grades 1, 2, and 3 (PNW system of grades) showed no differentiation in price, and averaged about $1.50 per M below the values of Grade 3 ponderosa pine logs. Grades 4 and 5 logs of sugar pine were comparable in value to similar grades of ponderosa logs. The report for this study has been completed in rough draft.

Douglas-Fir. The first of a series of production studies in Douglas-fir mills was started at the Rosboro Lumber Company on November 25. In this study commercial (Puget Sound) log grades are being used, and the grading is done by a grader furnished by the Pacific Log Scaling Bureau. The lumber grading is being done by an inspector-grader furnished by the West Coast Lumbermen's Association. Technical men are being supplied by the Station, by the Division of State and Private Forestry, by the Willamette Forest, and by the O. and C. Land Grant Administration. Laborers are furnished by the company. The entire output of this company is yard stock, all of which is kiln dried. During the study the lumber will be followed through the kilns and planers.

WOOD PRESERVATION

Northern Rocky Mountain.

Since October 1, Whitney has prepared ten reports on service tests. Five of these are the final reports on tests of the effectiveness of various forms of Anaconda Wood Preservative. In three experimental telephone lines, the serviceability of lodgepole pine and Douglas-fir poles treated with 5 pounds of Anaconda treater dust or granules per pole at the time of setting varied considerably, ranging from an average life of only 6.1 years to 12.5 years. Only one of these installations indicated that preservative treatment with either treater dust or granules would give a 5-year increase in the service life of telephone poles. Lodgepole pine and Douglas-fir fence posts treated with Anaconda Wood Preservative dust (average of 3 pounds per post) showed an increased life of about 3 years for the Douglas-fir and 2 years for the lodgepole pine.

In 1930, after the Anaconda Copper Mining Company had discontinued the sale of both treater dust and granules in favor of the paste form of preservative still being promoted, a few hundred poles and telephone stubs were treated experimentally by the Forest Service in this region. A final report on 47 western larch poles treated in the Seeley Lake district of the Lolo Forest was recently prepared. After 9 years of service approximately 24 percent of these poles were so badly decayed as to be unsafe for climbing and, in addition, 21 percent had been considerably weakened below the ground line by decay. Therefore, as a matter of administrative expediency with a view to preventing possible accidents, and to take advantage of help available from a CCC crew doing other maintenance work in the district, all of these

poles were reinforced with butt-creosoted lodgepole pine stubs in June 1939. Since quite a number of these poles would have given some additional service without reinforcement, it is estimated that if there had been no disturbance of the preservative treatment on such poles by stubbing, the average life of the paste-treated poles in this test would have been approximately 13.5 years.

The latest inspection of an installation in the Gallatin Forest (Bozeman-Flathead telephone line), which included 136 lodgepole pine stubs treated with an average of 7.4 pounds of Anaconda Wood Preservative paste and set in 1930 for comparison with other methods of treatment, shows that after 9 years of service 41 percent of the paste-treated stubs were still in good condition and 59 percent contained decay. However, with only about 15 percent badly decayed in 1939 and none removed because of decay, it is reasonable to expect an average life of 12 or 13 years from these paste-treated stubs, or almost double the service life of the untreated lodgepole pine stubs in this test.

FOREST AND RANGE INFLUENCES

EFFECT OF COVER ON CLIMATE

Rocky Mountain

Influence of a Pine Plantation on Local Climate. Data collected for nine years in a jack pine plantation and on an adjacent open site, near the Halsey nursery, show that the planted trees exert an appreciable influence on climate within the area. The most conspicuous influence is on wind movement and evaporation from Bates evaporimeters; both are greatly reduced inside the plantation. During the nine years, wind movement was only 28 percent, and evaporation only 60 percent of corresponding rates in the open area. Benefits due to this reduction in evaporation may, however, be partly offset by the fact that the tree crowns intercepted 4.76 inches (26%) of the average annual rainfall (18.11 inches). Except during the hottest part of summer days, air temperatures in the plantation were consistently lower than outside. Soil temperatures were warmer in the winter and cooler in the spring, summer, and fall inside the planted area.

Allegheny - Northeastern

General. The Snow Survey Outline for the Allegheny Preliminary Examination, Connecticut Survey, and Upper Susquehanna Survey for the winter of 1940-41 was completed.

Professor F. T. Mavis of the Civil Engineering Department of Pennsylvania State College is planning streamflow investigations for small upstream watersheds in the vicinity of the Standing Stone Experimental Forest. It is hoped that these investigations will be conducted in such manner that information obtained will be valuable to Flood Control. In order to meet this desire, Mollenhauer contacted the State College to establish cooperative relations with State College concerning the proposed investigation.

A joint public hearing between the Department of Agriculture and the Department of War for flood control on the Winooski River was held at Burlington, Vermont, on October 25, 1940. This hearing was attended by the Working Committee following a 2-day field reconnaissance of the watershed. From this reconnaissance it appears that the forest cover is largely young growth which is generally in fair condition except where good cutting practices have not been observed. Fire does not appear to be a serious problem in the watershed. The tributary streams have steep gradients in the upper reaches. These are principally forested as are the valley sides generally. The bottom lands are broad and cleared, with hay and pasture as the main cover. With the exception of the lower valley, cultivated land is a minor factor. There appears to be considerable stream bank cutting in the lower reaches, particularly in the broad valleys where the banks are usually of deposited material.

Preliminary Examinations.

Solomon Creek. Solomon Creek, a small tributary of the Susquehanna River, discharges through the city of Wilkes-Barre, Pennsylvania.

Although only about 18 square miles in total area, an estimated damage of $750,000 to Wilkes-Barre property gives this small watershed considerable local importance. The Department of Agriculture authorized a PE early last October.

The watershed is typical of considerable area in the Anthracite Region and other parts of Pennsylvania; the entire upper half of the basin is in forest cover, the lower half being forest, idle, urban, and industrial; the forest cover has been cut and burnt

until little remains but a few scattered wolf trees, worthless sprouts and brush, with considerable area completely denuded of all vegetation. Some ridge tops and sides have been eroded to bare rock. This has been so severe as to give rise to a question of whether any remedial cover program is feasible.

Based on the small area, high recreational values, active local interest arising from relatively high damage, availability of fairly accurate cover history and possibilities of a revised land use program for erosion and flood control, this watershed offers an ideal guinea pig for developing an action program which would treat an entire basin acre by acre instead of the present empirical projection from sample areas. Such an approach would be more nearly on a par with present U. S. Engineers' methods in which a survey lays out complete plans for an action program detailed to the point where actual work can be started. Such a procedure appears practical on Solomon Creek.

Besides dealing with forest and idle land cover and runoff relations, it must consider how these affect mine water resulting from surface flow, stabilization of mine refuse banks, and other land misuse problems common over large areas of Pennsylvania forest and idle lands. High corollary benefits are available from recreation and timber production.

Because of the possibility of erosion having proceeded beyond the point of redemption, the usual procedure of collecting damage data first is being reversed since the U. S. Engineers have established a tentative damage estimate which is considered sufficient to carry on a cover investigation. This figure will be accepted until a determination is made as to the possibilities of remedial control measures through vegetal cover changes. If these appear feasible, detailed damage and hydrologic data will be collected and analyzed.

Watershed Surveys

Connecticut. Field work for the farm woodlot portion of the detailed survey was completed for all watersheds above Bellows Falls except for the Stevens and Wells Rivers. It has been determined that information for the forest areas in the upper Connecticut can be projected from the White and Green Mountain National Forests and Coos-Essex Cooperative Project to cover the entire upper Connecticut area. This projection will be greatly facilitated through the use of aerial photographs, which are available for nearly all the upper Connecticut regions. Soil moisture depletion on volumetric basis has been completed on several gaged areas; however, little office work has been done to date. An examination of the hurricane damaged woodlands indicates that there has been up to three inches of humus lost on areas formerly well stocked with white pine and which now contain no tree growth.

Merrimack. The survey report has been reviewed by the Working Committee, and several suggestions and criticisms of the report have arisen which must be ironed out before submission to the Coordinating Committee. Specific criticism by Mr. Derr regarding the untenability of major land use revisions which disregard changes in watershed economy are being checked.

Appalachian

Preliminary Examinations and Advance Studies. During October and November a concentrated effort was made toward the completion of the Preliminary Flood Control Report for the Roanoke Watershed. It is planned that the final draft of the report should be ready by the end of December or early January.

Efforts toward collecting basic rainfall and run-off data for the August 1940 floods were continued. Collection of rainfall data is now about complete and field crews in cooperation with the Geological Survey are measuring slope-area sections for calculations of peak discharges. Thirty prospective sites for peak discharge measurements were located within the Roanoke, New and James River watersheds. The sites were selected to obtain peak discharges on unmeasured streams representing the broader soil and land-use areas within these watersheds. Sites tentatively located for field measurement include 12 on the Roanoke River, 11 on New River, and 7 on James River. Field work on the Roanoke River will be completed by December 5 or 6 and it is estimated that the field job on all three watersheds will be completed by the end of December.

Watershed Surveys. Studies on the Potomac River Survey, with a few exceptions, progressed during this period generally about on schedule. With the one month extension granted for completion of this survey, due to personnel losses from various causes, the survey should be completed and the report prepared by April 1.

The revision of the Coosa Flood Control Survey Report which is to be undertaken shortly will draw heavily on the personnel of the Pee Dee Survey. Tentative plans are to close the Pee Dee Survey temporarily, utilizing the entire personnel on the revision for about three months. In view of this interruption of work on the Pee Dee Survey, the staff members are preparing progress reports on their work to assemble an interim report, if time permits, before undertaking the Coosa revision.

Central States

Preliminary Examination

Scioto River. Progress on the preparation of the report has been delayed by field work on the Cumberland Preliminary Examination.

Wabash River. Infiltration studies are under way on this examination, but active field work will not be undertaken until the analyses of data on the Cumberland Preliminary Examination is complete.

Cumberland River. Field work on the Cumberland is practically complete except for damage appraisal by the B.A.E. An extensive method of planning land use changes through contacting County Planning Committees was given a trial on this watershed, with some measure of success. It appears, however, that the work has not yet progressed sufficiently for it to be of material value for extensive recommendations.

Watershed Surveys

Little Sioux River. The forestry aspects of this survey have been postponed to take full advantage of favorable weather for infiltration studies. With colder weather at hand, Richman, the only Forest Service representative, is completing his analysis of infiltration data and will sonn collect field data for the forestry section of the survey.

Intermountain

Sevier Lake Watershed. Although new type infiltrometer equipment (FA and F) did not reach the Sevier Lake Survey crew until late in the season, much valuable information was obtained during the fall on the infiltration characteristics of high and low flood source areas within the mountainous, herbaceous range types.

Tests with FA equipment showed the infiltration rate of low flood source areas to be about eight times greater than that of the high flood source areas. The infiltration rate on the range areas with a normal cover averaged about 4.00 inches per hour as compared to a rate of about 0.50 inch per hour on deteriorated range.

Comparative tests with the F equipment indicated the infiltration rates to be somewhat lower (approximately 1.33 inches per hour on low flood areas and 0.25 inch per hour on high flood source areas). Additional tests will be necessary in order to establish valid relationships between results obtained from the F and FA apparatus.

Tests with the old type North Fork apparatus on the average revealed very little difference in the infiltration rates on the high and low flood source areas. Rates obtained from tests on low flood source areas were essentially similar to those obtained on comparable areas with the FA equipment; i.e., about 4.00 inches per hour. The equally high or higher rates obtained with the old type North Fork equipment on low flood source areas are believed to be erroneous and due to the absence of rainfall impact. The unnaturalness of the "mist" produced by the North Fork equipment appears to be one of the principal features which precludes its use on studies in this region where impact of raindrops is an important factor in soil disturbance and infiltration rate.

The type F and FA equipment was found to operate reasonably well in the short time available for trial, although experience indicates several features could be improved. Chief among the improvements needed are: (1) a stronger pump, (2) a more durable and accurate pressure regulator, and (3) more durable and uniform nozzles.

A detailed report of the infiltration tests is now being prepared for submission to the Hydrologic Subcommittee of the F.C.A.C.

Lake States

Report on the preliminary examination of the Root River was submitted to Washington. A plan for advance hydrologic studies was also submitted with the report but no action has been taken on the latter as yet.

As a result of the recent decisions of Field Committees 14A and 13B, preliminary examinations will be concentrated on the small tributary watersheds of the Mississippi entering between La Crosse and Prairie du Chien. In order that records might be obtained of the spring-breakup floods, several stage recorders have been set out. In addition, a number of simple devices to record crest height have been established. Each of these consists of a 1½-inch pipe driven into the ground or set in concrete in which is enclosed a metal strip. This metal strip is coated with a glue which is soluble in water. A hole is made in the bottom

of the pipe to allow water to come in. The line of demarcation between the dissolved glue and that untouched by the water marks the crest stage.

Pacific Northwest

Preliminary Examinations and Surveys. Several preliminary examination reports await final approval. Unforeseen demands of the Walla Walla Watershed Survey have made necessary a concentration of effort on this project.

Chapler has been devoting most of his time to the Walla Walla Survey and Bolles is now detailed to the survey until at least the middle of December.

Cooperation of the Regional Office in flood control work is substantial and most gratifying.

Water Regimen Subcommittee. The work of this committee is progressing very satisfactorily.

Meetings. Field Coordinating Committee No. 22, consisting of Wyckoff, Selby of the BAE, and Christ of the SCS, spent two days on the Walla Walla Survey November 7 and 8, and the field working committee has had four sessions to Walla Walla during the last two months.

Southwestern

Meetings. On December 2, 1940, the District Engineer, Corps of Engineers, Los Angeles, and several of his representatives met jointly with the Field Coordinating and Working Committees 16-A in Tucson to discuss and lay plans for full coordination of the remaining work, data, and reports of the two Departments on the Gila River and Williams-Big Sandy watersheds. On the 2 days following the two Field Committees met to consider progress of work, to render decisions on specific matters presented by the survey crews, and to formulate a program that will bring about completion of the fiscal year's schedule on time.

Preliminary Examinations

Rio Grande. The ordinary preliminary examination report for the Rio Grande watershed above El Paso, Texas, was submitted to Washington in September 1940. Copies were also sent Regional Foresters of Regions 2 and 3 and the Rocky Mountain Forest and Range

Experiment Station for review and independent report, inasmuch as an important part of this watershed lies in Colorado.

Rio Grande Intensified PE-Advance Studies. The more intensive preliminary examination work authorized in the Rio Grande watershed for the current fiscal year is now well under way and comprises special studies (a) of the character and rate of siltation and their relation to sedimentation of Elephant Butte Reservoir and the channel bed of the Middle Valley; (b) of present grazing use and need for modifications; and (c) of those individual areas subjected to recurring damage by floods.

Watershed Surveys

Rio Puerco Survey Report. Representatives of the Washington review subcommittee are now in Albuquerque working with representatives of the survey crew in the revision of the Rio Puerco survey report.

Upper Gila Survey Report. At the meeting of the Coordinating and Working Committees plans were laid for pushing the survey and report for the Upper Gila watershed through to completion. It was decided that the scope of this report should comprise a comprehensive program of land conservation and management in the Upper Gila and that it should include two or more alternate remedial and action programs, carefully distinguishing between operations directly and indirectly flood control and operations wholly outside the Flood Control Act.

Pecos Survey Project. Analysis of data and preparation of the survey report for the Pecos River is 90 percent completed and should be ready soon after January 1. The Roswell office will be closed December 31 and the work completed at Albuquerque.

Colorado River Drainage Basin. The meeting of the Colorado River Drainage Basin postponed from last September, was held jointly with the Bonneville Lake and Lahontan Basin Committees and the Committees of Fourteen and Sixteen at Boulder City, Nevada, November 15 and 16. A meeting of representatives of all USDA bureaus interested in water development and conservation projects in the three basins was held on November 12 and 13, with total attendance of 13, representing five bureaus of the Department. At this meeting the USDA group reached a common understanding of their responsibility and laid out a course of procedure to be followed in the future on all matters referred to the USDA Basin subcommittees.

Special Gila River-San Carlos Reservoir Investigation. The Interdepartmental Subcommittee, appointed by the National Resources Planning Board to investigate the situation surrounding the shortage of water behind San Carlos Dam on the Gila River in central

Arizona, has now made its report to the Board. This report, it is understood, is now before the two interested Departments for consideration and will not be available for general release until it has cleared those Departments and the Board.

INFLUENCE OF NATURAL VEGETATION ON STREAMFLOW

Appalachian

Streamflow Debris Measurement. In cooperation with Arthur of the Washington Division of Engineering, plans for a large debris collecting installation have been designed for a 23-acre drainage area on the Coweeta Experimental Forest. This area has been cleared after a five-year period of standardization and will be used to study the effect of mountain agriculture on water resources. The plan agreed upon consists of a series of three almost level unloading platforms constructed in tandem, each platform differing from the other by about four feet in elevation. The stream is led from one platform to the next over a 1-1 sloping channel. The lowest platform leads to a 50'x50'x8' silting pond. The platforms themselves are each 20'x35' at the bottom and have 1-1 sloping sides. Provisions are made to use baffles spaced 7 ft. apart along the floor of each unloading platform. These baffles will vary from 6 inches to 2 ft. in height and are constructed so that they may be varied in height or position to serve most effectively in unloading the stream. The main channel will be constructed of cement. The sloping walls will be made of flat stone in mortar. The silting pond will be unlined but will have a crested spillway over which excessive flood flows will be measured should the Columbus weir above the unloading platform become incapacitated during the storm. The construction of the unloading platform is already under way, using CCC labor from the camp located on the Coweeta Experimental Forest.

This design was made to fit the special topography on which it is being installed. Its principle, however, can be applied to any sloping area.

Rehabilitation of a depleted area. First steps in the rehabilitation of a badly depleted and overgrazed watershed under experimental observation for 6 years have been completed for Drainage Area No. 3 on the Bent Creek Experimental Forest. The study is being conducted in cooperation with the North Carolina Agricultural Experiment Station. During the past two months the Agricultural Experiment Station has carried out a thorough discing of the area, followed by the sowing of one bushel of rye per acre. Prior

to the discing, the land was treated with 64 pounds of phosphoric acid per acre and one ton of limestone.

The Station has modified its weir installation on the area to take care of flood discharges and debris accumulation by enlarging the ponding basin and raising the stilling well above the danger line from unusual flood flows. The maximum runoff obtained from the area to date is 1,400 c.s.m. There are numerous records of peak discharges exceeding 600 c.s.m.

Analysis of Records. In November, 1940, a check of complete streamflow records showed that 9,360 weeks of stream runoff from experimental drainage areas had been analyzed by natural breaks on the hydrograph. Expressed for a single stream, this is equivalent to 180 years of continuous records. These data have also been summarized as mean daily cubic feet per second per square mile, and expressed as monthly and annual area inches of runoff. These data have made possible the development of an accounting system for current storage within individual drainage areas.

California

The hydrologic year 1940-41 was started by a storm which yielded from 2 to 2½ inches of rainfall during the period October 25 to 27. Intensities were gentle and very little increase in streamflow was recorded; no erosion occurred either from watersheds or plots. Following this storm, a period of very dry weather was produced by a more or less continuous flow of air from the desert regions to the north of the San Gabriel mountains. This dry spell was severe enough to require temporary extension of the fire season which had been terminated during the storm. Storm number two occurring on the seventeenth and eighteenth of November produced from 1½ to 2 inches of rainfall. This storm was also of a very gentle intensity and therefore produced small streamflow peaks, no erosion occurring. This average rainfall of about four inches to date on the forest puts our rainfall total about one-half inch above the average for the past six years.

As the first step toward a survey of the soil occurring on the forest, depth measurements have been made at 1/4 mile intervals along all of our raingage trails except two in Big Dalton. The Fern and Bell Small Watersheds were sampled in much greater detail than the Intermediate Watersheds. The following table gives the average depth of soil for each watershed. No figures are given for the Big Dalton watersheds because sampling has not been completed and too few observations have been made in those areas to obtain a reliable average of the soil depth.

Watershed Number	Area Acres	Average Soil Depth Inches	Volume of Soil Acre Feet
I	1,555	12.7	1,642
II	1,395	15.0	1,752
III	1,370	12.4	1,414
IV	3,584	13.4	4,007
V	2,765	14.5	3,340
VI	8,576	13.5	9,665
VII	1,088	22.3*	2,026
San Dimas	10,250	13.8	11,808
Entire Forest	13,111	14.1	15,392
Bell 1	77	21.2	136
2	101	12.7	107
3	62	21.0	108
4	37	27.2	84
All Bell	187	19.1	435
Fern 1	35	13.2	38
2	40	12.8	43
3	53	13.6	60
All Fern	128	13.2	141

* Probably too high, need more samples

The average depths for Bell 1, 3, and 4 appear to be too high so it is planned to take over a hundred more depth measurements in these watersheds to check the reliability of the average. Two hundred thirty-eight depth measurements were made in the Fern Small Watersheds at uniform distances along the contour trails so the average depths as obtained for those areas is probably reliable.

In addition to these depth measurements, a system of soil moisture sampling has been started in Watershed X to obtain preliminary figures upon movement of water into and out of the soil. These samples are taken at five locations in the watershed. Sampling is carried on at three-inch increments through the depth of soil. The first samples were taken before the first storm, and additional ones have been taken periodically since. It is planned to continue this sampling throughout the season.

Lysimeters. The San Dimas lysimeters entered on their second stage of operation after being sown with grass seed. Bromus mollis was the species used and was collected on the San Joaquin Experimental Range. This preliminary grass cover will initiate root activity in the lysimeters and is planned to be maintained for a period of two years before the final treatment species are planted. The seed was sown during the period October 8 to 16, and germination

was observed on October 30. The stand is now about 1¼ inches high. Large Lysimeter #1 and four medium and four small lysimeters were left unsown and will be used to check results obtained from the others.

Seepage from the large lysimeters stopped during the period September 18 to October 5. The 2.20 inches of rain on October 25-26 did not start percolation, but a storm of 1.78 inches on November 17-18 started seepage from Lysimeters 1, 3, and 13 at a very slow rate.

The switchboard controlling the recording system was rewired and additional seepage and runoff transmitters are being installed.

Vegetation Survey. The vegetation cover on the Tanbark Surficial Runoff and Erosion Plots has been mapped yearly since they were established early in 1935. Table I shows the changes since 1935 in the cover density of the leading chaparral species. There has been a consistent increase in density of Ceanothus oliganthus, Cercocarpus betuloides, Photinia arbutifolia, Prunus ilicifolia, and Quercus dumosa which are all sprouting species. Ceanothus crassifolius, a nonsprouting, short-lived species, shows a decrease.

TANBARK SURFICIAL RUNOFF AND EROSION PLOTS

Table I

Density of Major shrub species*

Species	1935	1936	1938	1939
Adenostoma fasciculatum	.3	.3	.6	.5
Arctostaphylos glauca	.8	.8	.9	.7
Ceanothus crassifolius	13.8	15.6	18.9	15.3
Ceanothus oliganthus	4.6	6.1	7.2	7.8
Cercocarpus betuloides	7.2	7.7	9.2	10.2
Photinia arbutifolia	1.5	1.4	1.7	2.1
Prunus ilicifolia	.3	.5	.9	1.0
Quercus dumosa	24.1	28.7	32.7	34.0
Minor species	1.1	1.6	1.2	2.2
Total	53.7	62.7	73.3	73.8

*Density not determined in 1937 and 1940

Table II illustrates the considerable fluctuation in herbaceous cover on the plots. Rainfall seems to be a controlling factor in the density of the herbs. Late in 1936, the Tanbark plots were fenced to prevent further browsing by deer. This accounts for the low relative densities of the herb cover in 1935 and 1936.

TABLE II

Herb Cover Density Compared to Rainfall

Year	Herb Cover Density Percent	Rainfall
1935	9.3	32.84
1936	6.3	22.98
1937	21.1	41.70
1938	18.9	40.53
1939	8.0	20.20
1940	33.7	25.60

The Fern Canyon Surficial Runoff and Erosion Plots were established in 1934 and 1935. At this time the cover of these plots consisted almost entirely of the two species of oak (Quercus chrysolepis and Quercus wislizenii var. frutescens). The average height of the canopy was from 15 to 30 feet with little ground cover but a dense litter mat over most of the area. In November 1938 these plots were completely burned. The vegetation was re-mapped in the springs of 1939 and 1940. The most outstanding fact about the vegetation subsequent to the burn is its rapid increase between the summer of 1939 and the summer of 1940. In fact, the density is greater than before the fire; however, this cover consists mainly of Lupinus longifolius and Nama parryi with a height of two or three feet. These plants are shortlived perennials and will be of prominence until the sprouting oaks crowd them out. The litter layer is increasing rapidly but is as yet far below the amount found in the area previous to the fire.

Following the fire, one set of the plots was left undisturbed. The second set was given an erosion control treatment immediately after the fire by cutting the standing fire-killed oaks and laying this material across the plots in contour rows about three feet apart. The third set of plots was planted to mustard, Brassica nigra. On the terraced plots there was considerable litter the first year compared with the natural and mustard series, but this was due to the wood material contained in the terraces. There was not much increase of litter on these plots between 1939 and 1940, probably due to the fact that what litter fell from the vegetation accumulated in the crevices of the wood terraces. The mustard was kept from growing satisfactorily on the plots planted with it by the rapid development of native vegetation.

Table 3.--Fern surficial runoff and erosion plots

	Natural			Terraced			Mustard		
	1935	1939	1940	1935	1939	1940	1935	1939	1940
Crown canopy	48.8	--	--	51.4	--	--	47.8	--	--
Ground cover	3.8	12.3	77.0	2.9	14.8	65.9	2.5	8.7	84.5
Brassica nigra	--	--	--	--	--	0.1	--	0.6	4.6
Bromus tectorum	--	0.1	0.9	--	0.1	1.0	--	--	0.1
Ceanothus integerrimus	0.8	0.2	0.7	0.1	0.2	0.4	--	0.2	0.6
Crytantha intermedia	--	0.1	2.9	--	0.2	5.4	--	--	0.4
Garrya veatchii	--	0.1	0.1	0.3	--	0.1	--	--	--
Gilia gilioides	--	0.1	0.2	--	0.1	1.8	--	0.1	0.4
Lonicera subspicata	0.4	0.1	0.1	0.2	0.1	0.1	0.5	0.1	0.1
Lupinus longifolius	--	0.8	42.3	--	0.1	20.9	--	1.2	58.3
Melica imperfecta	0.1	--	0.6	0.1	--	0.5	0.1	--	0.2
Nama parryi	--	0.2	8.6	--	1.2	6.2	--	0.1	0.4
Pentstemon ternatus	0.6	0.1	0.1	0.2	--	0.2	--	--	--
Phacelia brachyloba	--	6.8	1.0	--	8.3	0.9	--	1.9	0.2
Quercus chrysolepis	28.8	1.1	8.9	41.0	2.2	18.9	45.2	3.1	16.3
Quercus wislizenii var. frutescens	20.9	2.2	9.9	11.9	1.5	7.6	3.8	0.8	2.0
Velaea arguta	0.4	0.2	0.1	0.1	--	--	0.2	0.4	0.1
Minor species	0.6	0.2	0.6	0.4	0.8	1.8	0.5	0.2	0.8
Litter cover percent	91.9	1.9	24.5	89.3	16.6	23.9	92.5	1.9	28.0

Note: All plots burned November 1938

Intermountain

New Stream Gaging Stations. The October report (page 87) referred to the "concrete and rubble control sections equipped with stilling wells and watershed recorders," installed on the experimental watershed at the Wasatch Branch Station. These installations constitute a new approach, insofar as this Station is concerned, to the problem of measuring greatly fluctuating stream flow on steep gradient streams where high bedload or even mudflows must be passed through measuring devices.

Briefly stated, this new type gaging station consists of: (1) a streamlined rubble channel with a "V" bottom sloping 1:6 from center to side walls, and with side walls sloping 1:1; (2) cut-off walls on both ends of the control section; (3) a stilling well located a safe distance back from the flume, with an extension under the flume bottom to the center line; (4) a system of pipes placed in a vertical plane at frequent intervals in the wall by which water may pass from the channel to the stilling well; and (5) an instrument house and water stage recorder.

The "V" bottom permits measurement of very small quantities of water--as little as 10 G.P.M.--and concentrates the bedload and water so that all debris entering is washed through the flume. The intake ends of pipes to the stilling well are equipped with perforated plates which prevent entrance of debris greater than one-fourth inch in diameter. Then, too, bedload is carried so rapidly past the portals that only very small quantities enter the pipes.

The matter of head relationship in the flume and in the stilling well has been given careful consideration. When the inlet pipe openings are exactly flush with the flume bottom and parallel to the axis of the flume, true heads are recorded in the stilling well. Velocity heads are produced only when the slope across the intake pipe opening is less than the slope of the axis of the flume. Placing a perforated face on the intake pipe opening eliminates all trace of velocity head under a variety of conditions tested. No possible adjustment of the intake pipe portals was sufficient to produce negative heads in the stilling well.

Rating curves are being developed for the normal seasonal range of flow by using weirs and current meters. Rating for maximum stages will be done theoretically, using Chezy-Kutter and related formulas.

These flumes have been installed in creeks having gradients as high as 24 percent.

Water Utilization (Bunchgrass-granitic soil). Total water utilization and losses from 4-foot deep granitic soil supporting a partially complete stand of herbaceous vegetation has on the average amounted to about 50 percent of annual precipitation during the past five years according to records from the six 2-milacre lysimeters at the Bannock Creek Substation near Idaho City, Idaho (table 1). The losses have ranged from 4.21 inches in 1937 to 16.72 inches in 1938. Greatest losses occurred in years of highest precipitation.

Table 1.--Average yield and losses of water from six lysimeters, Bannock Creek Substation, near Idaho City, Idaho, 1936-40.

Years 10/1-9/30	Annual Precip. (Inches)	Water Yield (Inches)	Water Losses (Inches)
1936	24.55	10.36	14.19
1937	15.60	11.39	4.21
1938	31.20	14.48	16.72
1939	17.31	7.28	10.03
1940	25.23	11.51	13.72
Average	22.77	11.00	11.77

Water yield from the soil tanks has occurred mostly in the form of seepage flow, surface run-off having amounted to only 3.0 percent of the total yield in 1936, 1.0 percent in 1938, and 1.1 percent in 1939. As in the case of losses, variations in water yields from year to year have corresponded rather closely to fluctuations in annual precipitation, except during the second year of record--a very dry year--when relatively high yields were obtained. The latter irregularity doubtless is due to relatively high recharge late in the 1936 stream flow year.

In 1938 the tanks were planted to herbaceous cover, two each to a mixture of climax bunchgrasses, two to a mixture of perennial grasses and weeds, and two to a mixture of annual grasses and weeds. The plantings have been fairly successful but it is expected that it will require another two or three years to obtain the desired composition and density of vegetation on the plots.

An inspection of individual plot data shows that variations in yields and losses between plots were relatively less during the first three years of record when they were either bare or supported only annual weeds than during the past two years when some of the tanks supported perennial plants. An analysis is now underway to determine the extent to which differences in yields and losses are due to changes in the plant cover.

Rocky Mountain

Interception of summer rainfall by lodgepole pine.-- This experiment was divided into two phases; (1) to measure interception by tree crowns, and (2) to measure volumes of water returned to the soil by stemflow. In the interception study, 100 Forest Service rain-gages were distributed in 5-gage groups over a series of 20 silvicultural plots. Within each 5-acre plot, one gage was set in a large canopy opening selected at random; another gage was placed at a distance of 66 feet in each of the four cardinal directions from the "open" gage.

Rainfall interception was considered to be the difference between "gross" rainfall measured in the open gage, and "net" rainfall expressed by the average of readings in the 4 gages surrounding it.

With all plots in a virgin condition, interception records were collected during the summer seasons (May - October) of 1938 and 1939. During the winter following this period, four of the plots were clear-cut by commercial methods, four plots each were left with reserve stands of 6000, 4000, and 2000 board feet per acre, and four plots remained uncut. Interception records for the 1940 season have clearly shown increases in "net" rainfall as a result of the cutting.

As shown in the accompanying table, approximately 30 percent of the rainfall in all three seasons was intercepted by tree crowns in the uncut stands. By contrast, only $8\frac{1}{2}$ percent interception occurred in clear-cut stands, from which all merchantable trees over 9.6 inches dbh had been removed. The other degrees of cutting showed quite comparable reductions in interception losses.

Further analysis of these data will show the influence of storm size on interception. Final analysis will be made by the covariance method, using mean interception figures adjusted to a constant storm size, and employing 1938-39 values of interception as a concomittant variable to adjust the effects of cutting treatments for past performance of the individual plots.

The stemflow phase of the study was designed to evaluate the influences of storm size, species (lodgepole pine, alpine fir, and Engelmann spruce), diameter, crown class, and cutting on stemflow. Flow from one hundred and eight trees was collected by lead collars and collection cans: one tree in each of the three species, two treatments (cut and virgin), three crown classes (A, B, and C by Taylor's classification) and 6 diameters ranging from 4 to 14 inches dbh.

Stemflow occurred in only 9 of 43 storms which produced 11.3 inches of rainfall between May 12 and October 9, 1940. Assuming an average crown diameter of 10 feet, the stemflow per tree totalled less than 0.01 inch of rainfall for the whole season.

Even though this quantity is quite negligible, variance and co-variance analyses of the stemflow produced results of some academic interest. Diameter, crown class, and cutting exerted no measurable influence on stemflow. Species, on the other hand, showed a strong influence: spruce produced the least stemflow, and pine the greatest volume. Stemflow was also correlated well with storm size in a positive straight-line relation; again, spruce showed the weakest trend, and pine the steepest regression line.

With completion of this study, it is planned to initiate similar experiments in aspen and, later, in the spruce-fir type.

Interception of summer rainfall in lodgepole pine - Fraser Experimental Forest.

	Intensity of treatment				
	Virgin	Light	Medium	Heavy	Clear
Before treatment, 1938 - based on 32 storms					
Merchantable volume	11,890	12,770	12,200	10,710	12,740
Ft. B.M. per acre	7.10	6.90	7.33	7.08	7.16
Gross rainfall, inches	4.80	5.13	5.01	5.08	5.17
Net " "	2.30	1.77	2.32	2.00	1.99
Interception, inches	32.4	25.6	31.6	28.2	27.8
Interception, percent					
Before treatment, 1939 - based on 15 storms					
Merchantable volume	11,890	12,770	12,200	10,710	12,740
Gross rainfall, inches	3.64	3.50	3.86	3.62	3.75
Net " "	2.38	2.43	2.70	2.59	2.74
Interception, inches	1.26	1.07	1.16	1.03	1.01
Interception, percent	34.6	30.6	30.1	28.4	27.0
After treatment, 1940 - based on 43 storms					
Merchantable volume	11,890	6,000	4,000	2,000	0
Gross rainfall, inches	11.00	10.92	11.31	10.96	11.18
Net " "	7.85	9.66	10.54	9.83	10.23
Interception, inches	3.15	1.26	0.77	1.13	0.95
Interception, percent	28.6	11.5	6.8	10.3	8.5
Ratio of interception percent before treatment to that after treatment ($\frac{1938\text{-}39}{1940}$)	1.15	2.66	4.43	2.76	3.18

Measurement of Water Applied to Infiltrometers. As a supplement to the infiltration study reported in the October bi-monthly report (page 88), a detailed check has been made of the accuracy of rainfall measurements made by trough gages and rain-cans placed over infiltrometers.

Rainfall on the types "F" and "FA" infiltrometers is ordinarily measured by "pan" readings taken before and after each infiltration test. While this method gives an accurate measure of total precipitation at the two times of measurement, it may not be relied upon--except under highly controlled conditions--to give a reliable estimate of water applied during the actual test. For this reason it is believed safer, for ordinary field working conditions, to measure the rainfall applied during the run itself by means of rain-gages placed over the plot.

As a test of the accuracy of such measurements, an experiment was designed to compare directly the catch in rain gages with the total water applied to plots. A type "F" plot was made impervious by a screened pan covering its whole area, over which were placed two trough rain-gages (1.00" x 12.5 feet), bisecting the longitudinal halves of the plot. A type "FA" (1.0 x 2.5 foot) plot and a Rocky Mountain (2.0 x 4.0 foot) plot were similarly equipped with screened pans. Over the smaller plot were hung six cans, each 0.992 inch in area and four inches deep, and spaced in two rows at regular intervals over the plot area. The larger plot was equipped with similar cans, hung in three rows of four gages.

Spray was applied by means of type "F" sprinklers at a rate of about four inches per hour, with five 10-minute applications on each plot and for each of several nozzle settings. On the type "F" plot, for example, the nozzles were first placed in the standard position, then staggered to the right in order to give a badly skewed distribution of rainfall. Later the nozzles were set toward the left, then with the pattern too wide or too narrow in order to complete the picture of possible field errors. Similar procedures were followed in sprinkling the smaller plots, except that with a single bank of sprinklers the band of rainfall could not be varied in width. In addition, however, the single group of sprinklers was placed at distances of three inches and 12 inches from the plot frame.

Results are summarized in the following table:

(Infiltration Methods Study, 1940)

Comparison of rainfall measured in gages with total precipitation measured by pans

	Precipitation in 10-minute interval			
	Gages	Pan	Difference	Error[c]
	Inches	Inches	Inches	Inches
Type "F" plot (trough gages)				
Spray centered	0.561	0.569	-0.008	±0.004
" left	.579	0.572	+0.007	
" right	.589	0.578	+0.011	
" steep	.525	0.534	-0.009	
Ave. Diff.			+0.001	
Rocky Mt. plot (12 1-inch cylinder gages) - 2x4 foot plot.				
Spray centered	0.747	0.696	+0.051	±0.019
" left	.680	.621	+ .059	
" right	.641	.593	+ .048	
Noz. 3" from plot	.684	.628	+ .056	
Ave. Diff.			+ .053	
North Fork (type "FA") Plot (6 1-inch cylinders).				
Spray centered	0.589	0.519	+0.070	±0.011
Spray left	.631	.575	+0.056	
" right	.684	.653	+0.031	
Noz. 3" from plot	.644	.592	+0.052	
Ave. Diff.			+0.052	

[c] This error is the root mean square of the interaction between 10-minute time intervals and methods of measuring rainfall.

The trough gages on the type "F" plot showed remarkable agreement with pan readings for all nozzle positions, and the error of these gages was so small as to be negligible. Although the 1-inch cans gave readings about 8 percent high, they also showed excellent consistency and a relatively small error. Again, no significant difference in readings was caused by shifting the spray pattern.

Southern

Hoover-Nesbitt Creek Watershed Studies, Irons Fork Experiment Forest. During the summer months excavation of gaging points No. 1 and No. 3 was carried on with CCC labor. Plans are being drawn up in the Regional Office for a modified Columbus deep-notch weir designed to measure peak flows of over 350 c.f.s. from the

West Nesbitt Creek watershed of 156 acres. The approach will consist of masonry debris and ponding basins; the former of sufficient size to handle all the expected bed load movement above the control. The Ouachita National Forest will handle the engineering phases. When completed the weir will be the first permanent watershed control on the Irons Fork Experimental Forest.

STABILIZATION OF SOIL

Southern

Roads

Fall examination of the roadbank-stabilization study established last May in cooperation with the Ouachita National Forest has revealed no outstanding success for any one treatment at the end of the first growing season. Although conclusive results cannot be obtained until at least the end of the second growing season, indications apparent from the first year's growth are that:

1. Additional studies are needed to determine the effect of brush cover on vegetative growth.

2. Litter-mulch treatment with brush cover costs less than vegetative treatments (with the exception of the Bermuda mulch treatment) but produces the least vegetative cover during the first growing season.

3. The use of some form of topsoil treatment apparently gives better results than a treatment without topsoil and, although costing more, may be more economical in the end.

Summarized below in tabular form by treatments are the unit costs and estimated density of vegetative cover. The data are based on 9 replications of each treatment on plots of 200 square feet in area. Due to the limited size of the plots the cost figures are excessively but uniformly high. It is planned to carry on additional tests using different combinations of operations in an endeavor to decrease costs of treatment application.

In June, 24, 200-square-yard roadbank plots were established on National Forest roads in a study to test the effectiveness of TVA calcium metaphosphate fertilizer in increasing vegetative cover. Four rates of application (100, 200, 400, and 800 pounds per acre) were used on each of six classes of roadbanks as follows:

1. Untreated banks,
2. Recently weed-mulched banks with topsoil,
3. Recently weed-mulched banks without topsoil,
4. Year-old Bermuda sod-treated banks with brush cover,
5. Year-old Bermuda sod-treated banks without brush cover, and
6. Year-old weed mulch-treated banks.

Comparison of Costs and Vegetative Density for Shady Roadbank Plots - 1940 Growing Season

Distribution of Jobs by Treatments

Job	Treatment					
	1 Weed mulch	2 Litter mulch	3 Bermuda mulch	4 Bermuda sod with brush	5 Bermuda seed	6 Bermuda sod brush removed
Scarification	x	x	x	x	x	x
Stakes	x	x	x	x	x	x
Brush & poles		x	x	x	x	x
Litter		x				
Weed mulch	x					
Bermuda pieces				x		x
Topsoil				x	x	x
Bermuda seed					x	
Brush removal			x		x	x
Bermuda mulch			x			

Treatment Costs in Cents Per Square Yard

	Treatment					
	1	2	3	4	5	6
Collection	3.3	12.5	10.1	12.9	11.1	12.9
Application	2.9	5.1	6.7	9.2	6.8	9.5
Total	6.2	17.6	16.8	22.1	17.9	22.4

Vegetative Density and Ratings of Treatments

	Treatment					
	1	2	3	4	5	6
Density vegetation end of growing season	.05	0	.27	.40	.60	.28
Cost per sq. yd. per unit (.10) density	12.4	-	6.2	5.5	3.0	8.0
Relative rating	5	6	3	2	1	4

Each plot was subdivided and fertilizer applied to one-half by random selection. The experimental design calls for replication this fall and again next spring.

Conclusions based on examination of the plots at the end of the first growing season indicated that there was no apparent effect of the fertilizer or its rate of application on the growth, condition, or density of the vegetative cover. If differences exist it is expected that they will not be observable until the end of the second or third growing season.

Southwestern

Putting Leaves to Work. Erosion following deterioration of herbaceous vegetation is very rapid and destructive in diabase and granitic soil-type areas in the Southwest. In areas of steep relief, soil washing may result in the removal of many tons of soil and subsoil material annually and the cutting of deep gullies at the very head of small drainage systems.

A record of eroded material removed from nine small watersheds located in a granitic area on the Tonto National Forest shows a removal of 11,557 cubic feet of soil and subsoil material from 6 acres during the 9-year period July 1931 to September 30, 1940. This is equivalent to a loss of 1/2 inch of soil from the entire surface of the 6-acre area during the 9-year period. The shrub cover on these small watersheds has afforded partial protection from soil erosion, there being practically no erosion underneath shrub clumps. It is between shrub clumps where grasses and herbs have been depleted that deep gullies have been eroded.

Similar conditions exist in diabase and granitic areas throughout the chaparral zone wherever herbaceous cover has been depleted. Natural restoration of herbaceous cover under such conditions takes place very slowly for several reasons. Deterioration has resulted in the destruction of practically all perennial herbaceous vegetation, seed production is extremely limited and is confined to a few weak and sickly remnants. Much of the topsoils has been carried away by erosion. The exposed soils and subsoils dry out rapidly between storms and immature seedlings usually perish in the spring or fall dry periods.

Artificial control of erosion in these soil-type areas on a broad scale is considered out of the question because of the great cost such a program would involve. However, it is believed that under some conditions and at carefully selected points granite and diabase rubble can be impounded and kept out of stream channels and irrigation reservoirs at a reasonable expense by the use of wire or

rock and wire checks. However, such checks are effective only where the shrub cover on the eroded drainage sheds is sufficiently dense to provide litter for the sealing of check dams. Ordinarily, where shrubs form a cover of 0.4 density or better, sufficient litter is produced to take care of the sealing process.

The construction of several thousand check dams on the Bloody Tanks Wash on the Crook National Forest by the Civilian Conservation Corps and a number of dams of various types on the Sierra Ancha Experimental Forest has afforded an opportunity for observing the effectiveness of this type of control in both granitic and diabase soil-type areas.

Loose rock dams of various types, constructed of large rocks and chinked with small rocks, functioned very well but were costly to build.

Wire fences built in crescent shape with the bow on the down-stream side proved to be almost as effective and were much cheaper to construct. These fences were held in place by guy wires attached to a peg driven in the upstream side of the wash.

Rock dams and wire fences were ineffective in holding back sediment until hard, dashing summer rains brought down great quantities of litter. When the rains did come, the faces of rock dams and wire checks were literally plastered over with a mixture of leaves, twigs, duff, and mud. This material effectively sealed dams and fences, and from that time on they began to catch sediment. At the present time, most of the dams in both areas are full of sand and gravel. Examination of the wire dams shows an accumulation of leaves several inches in thickness between the wire face and the sandy fill behind. The leaves are matted together in such a way as to form a very tight blanket. Apparently the cheapest method to stop silt in the chaparral zone is to trap leaves and let them do the work.

RANGE RESEARCH

ARTIFICIAL REVEGETATION

Intermountain

Perennial Grass Seed. Research in artificial revegetation during the past several years has proved the value for range reseeding of a number of native grasses. These species have demonstrated an ability to establish and maintain themselves that places them on a par with crested wheat, slender wheat, smooth brome, and other widely used grasses and their extensive use in range planting apparently is waiting only for an adequate supply of seed.

The objective of any range planting should be the establishment of mixtures of palatable and nutritious forage species, not of pure stands of crested wheat or smooth bromegrass. The advantage of mixtures in pasture work are well known. The best utilization of each niche of the environment, the most efficient use of soil moisture and soil minerals, and the maximum production of palatable and nutritious forage throughout the grazing season are all attained through the use of mixtures. Crested wheat, slender wheat, and smooth brome are well nigh essential to the reseeding program, but many other species are urgently needed to permit planting of the best mixture on all sites within the region.

Widespread experimental and small demonstrational plantings of some very promising additional species from native stands have been made with seed collected at considerable expense. The feasibility of the commercial production of seed of these species is indicated by the facts that they are fairly rapid growers that will produce a crop the second year under ordinary conditions; they require little care; they yield sufficient quantities of seed so that it could be sold at a reasonable price; and no special equipment is required in the growing and harvesting of the crop. Seed collection from small plots indicates that yields of from 100 to 300 or more pounds per acre can be expected.

In an effort to get the commercial production of seed of desirable species under way, the Experiment Station has supplied seed of bluebunch, beardless, and bearded wheatgrasses (Agropyron spicatum, A. inerme, and A. subsecundum), blue wild-rye (Elymus glaucus), and big bluegrass (Poa ampla) to one farmer in Utah and one in Idaho under a cooperative agreement. Enough seed to plant at least one acre of all but the last species was provided each rancher with the understanding that for the first three years the Experiment Station would get half the seed to be used in further research and for demonstration planting to help build up the market, while the growers could use the other half, either for increasing their stands or for sale. It is hoped that after three years the production of these desirable species will be established on a commercial scale.

The question of production of seed of species already on the market deserves consideration. Such species as Kentucky bluegrass, tall meadow oatgrass, smooth bromegrass, and others that require fairly moist conditions, doubtless can best be produced in the Middle West, or Pacific Northwest. Slender and western wheatgrass are now harvested from native stands in the Great Plains, but in view of the apparent advantage of locally raised seed, local production in the Intermountain region seems justified. In addition, crested wheatgrass could doubtless be grown in this region more extensively than at present, and should form an increasingly important crop for Intermountain farmers.

It is thought that this seed production program will be mutually advantageous to farmers who produce the seed and to the range reseeding agencies that use it. With proper guidance to insure that worthwhile species are grown and that suitable sites for production are chosen, the local range grass seed business should handle many thousands of pounds annually after 1945.

A Giant Bluebunch Wheatgrass. During the 1940 field season a giant form of bluebunch wheatgrass (Agropyron spicatum) was observed growing in the ranger pasture adjacent to the Paradise Valley, Nevada substation. Tufts of about 25 plants, ranging from $3\frac{1}{2}$ to 4 feet in height of culm, and from 6 to 22 inches in basal diameter, occur within an area of 10 square rods. Scattered throughout this area are numerous plants of giant wild-rye, bitterbrush, big sagebrush, downy chess, and bluebunch wheatgrass of normal stature.

So coarse was the early growth of this wheatgrass that, prior to pollination, it was passed unnoticed among bunches of giant wild-rye of similar size. In both gross and definitive characters, this giant form is larger than the maximum limits given in Hitchcock's "Manual of Grasses of the United States," and nearly twice as large as plants of the typical species on the same site.

Some measurements follow: length of spikes, 17 to 25 cm., length of glumes, 1.3 to 1.6 cm., length of lemmas, 1.0 to 1.2 cm., height of plant, 100 to 120 cm., width of leaves, 4 to 6 mm.

In common with many other stands of the species, the giant form failed to set seed in 1940, and on this account no seed is at present available. In order to permit further observation, one large plant was separated into 60 clons and distributed for nursery planting at four work centers. Ten of the clons, after an interval of 9 days, were potted in the greenhouse in Ogden. Six of these have resumed growth.

It is possible that this form is a polyploid. A cytological study will be made during the winter in an effort to discover the cause of the gigantism. Bluebunch wheatgrass has demonstrated its value for range reseeding in numerous trials throughout the region.

This giant form will be tested in the nursery of the Intermountain Forest and Range Experiment Station in order to prove whether it be an improved strain. Should palatability and drought resistance be combined with high forage production of this strain it would be a valuable addition to grass strains tested.

Northern Rocky Mountain

Species Adaptation. Twenty grasses and five legumes, selected as the most promising species from a total of more than 100 accessions grown in the Missoula, Vigilante, or Miles City forage nurseries, were included in species adaptation test plantings on range areas this fall. Most plantings were made with a McCormick-Deering 1-horse disk drill on duplicated 1/10-acre plots. Typical range lands that had been plowed and since abandoned as croplands were chosen for the plantings, which were made without seedbed preparation. One area is situated in the Judith Basin, another about 35 miles to the northwest of Miles City, while the third, unplanted as yet because of continued unfavorable weather, but which will be reseeded either this fall or early next spring, lies in the Bitterroot Valley. The mean annual precipitation at these three work centers is approximately 15, 13, and 11 inches, respectively.

Other species adaptation test plantings made this fall include 10 grasses, planted in a depleted mountain park at 7,500 feet elevation on the Beaverhead National Forest, and 9 grasses planted on a recently logged ponderosa pine area on the Bitterroot National Forest at an elevation of about 5,000 feet. Adjoining the Bitterroot test plantings was a recently logged area of about 2,000 acres, where 175 acres in skid roads and burns was reseeded this fall, mainly to a mixture of crested wheatgrass, tall oatgrass, and yellow sweetclover under station guidance and supervision. This reseeding was a followup on very promising results on 25 acres seeded on a nearby area in April 1940. These reseeded areas in a logged and burned ponderosa pine type are near several small stock ranches that are in acute need of additional summer range, and the permittees are keenly interested in the trial.

The purpose of these adaptation test plantings is to determine which species are best suited for use in reseeding needy range lands under various sets of conditions. Crested wheat grass has already proved its adaptation to diverse conditions in Montana.

Appalachian

Beef Cattle in Eastern North Carolina. A survey of the beef cattle industry in the coastal plains area of North Carolina is now under way. This survey, with other contacts, is showing that a great interest in cattle raising has developed in the last year or two, and that there has been a large increase in number of cattle. As an illustration of the increase, the number of cattle in Washington County, where the Blackland Station is located, has gone from 600 to over 3,000 in the last two years. There are several reasons for this sudden increase, chief of which are: (1) high cost of farm labor, (2) low prices received for cash crops, and (3) high prices received for beef. Most farmers are starting out with only a few cattle and are expecting to "grow" into the business by keeping their heifers. The survey being conducted shows thus far that as the farmer grows into the business, he is planning either to stop growing cash crops altogether or to cut his acreage very low. This plan of operation will no doubt result in a lack of or high cost of winter feed and the main problems in management will center around wintering the animals and the carrying capacity of the grazing land.

According to local reports there were many cattle in eastern North Carolina before legislation was enacted about 1920 requiring farmers to dip for tick fever and to build fences to enclose their animals. Because of the trouble and expense of complying with these laws, most farmers stopped raising cattle at that time. Tick fever is no longer a source of trouble, and farmers are now building fences to enclose their cattle.

At the Blackland Station the cows and two-year-old heifers were put into the fall pasture on November 19. Covering about three-fourths of this pasture is a dense stand of reeds (Arundanaria tecta); and on the other quarter, which was burned severely several years ago, there is a mixed stand of wool-grass (Scirpus cyperinus), golden rod (Solidago spp.), dog fennel (Eupatorium capillifolium), panic grass (Panicum sp.), and groundsel-tree (Baccharis halimifolia). Observations of grazing for the first week after the cattle were turned in showed that the reeds made up practically all of the diet. Groundsel-tree was judged to be the most palatable plant in the pasture since almost every shrub showed moderate to close utilization at the end of the week. Because of its scarcity in the pasture, however, it made up only a small portion of the cattle diet. Wool-grass was grazed only lightly along routes of travel and was rated as low in palatability. However, in a reed pasture grazed closely during the summer and early fall, clumps of wool-grass showed practically 100 percent utilization. In the fall pasture, dog-fennel, golden rod, and panic grass have not been grazed.

California

Seeding Habits of Annual Plants. Annual plants as a rule are very heavy seed producers. They will seed early if climatic conditions are adverse, and even if grazed heavily they will still produce seed very close to the ground. The plants apparently do not need rest and a chance to build up reserves like perennial grasses.

The number of seed produced per unit area is illustrated by counts of broadleaf alfileria made by Biswell during the 1939-1940 season. On 26 circular plots, of four feet radius, distributed along a fence line separating a pasture grazed heavily over a seven months' period from one grazed lightly, an average of 537 seed were produced per square foot in the heavily used pasture, and 683 in the moderate to lightly used one. On four plots distributed down the same fence line and protected during this growing season 1,087 seed per square foot were produced, the number varying from 335 to 2,283.

The vast seed crop produced is also reflected, in some degree, by the great numbers of individual plants on a unit area, alluded to in previous reports. Most of these plants, of course, do not reach maturity.

Not all of this vast seed crop germinates every year, and therefore seedling counts do not reveal total seed production. Old residents have observed that even though precipitation may be so low some years as to allow little seed production it does not produce noticeable effects on the next year's crop, provided weather conditions are favorable to growth. Studies at the San Joaquin Experimental Range have shown that even when conditions for germination are good and dense stands develop, viable seeds are left in the ground for another year's crop. In the fall of 1937, for example, some sods of several species were selected from stands of nearly 100 percent density, just previous to any seed production, and removed to a room where the sods were allowed to dry. Any flowers that developed were picked off and care was taken to see that no seed were produced on these sods. The next fall, with the start of rains, the sods were placed outside and given additional water. A forage stand with an average density of 24 percent was obtained.

The heavy seed production and its development under adverse conditions, are important factors in the finding that only minor changes have taken place in pastures used at different rates on the San Joaquin Experimental Range.

Intermountain

Notes on the Effect of Degree of Use Upon Plant Vigor. Observations on the effects of current season's use upon plant vigor and yield were begun in 1937 and carried through the growing seasons of 1938, 1939, and 1940. Each year following the close of the grazing season four series of plants currently utilized to varying degrees are staked for observation during the two following years. At the end of the second year the plants are harvested. The series for slender wheatgrass, mountain brome, and Letterman needlegrass are as follows:

Series I	Fully utilized	95 - 100 percent
Series II	Heavily utilized	70 - 80 percent
Series III	Moderately utilized	35 - 50 percent
Series IV	Non-utilized	- 0 percent

For hairy geranium only three series have been established. These correspond to Series I, III, and IV.

The inception of spring growth usually occurs prior to the date of "snow off", which precludes making accurate observation of this growth phase. With grasses, in practically all instances, growth on all series was noted as soon as the plants were free of snow. With hairy geranium, the only weed species observed, often a lag of one to three days occurs after "snow off" before the leaf buds break through the soil. For this species there appears to be some evidence that the fully utilized series is a day or two later than the other series. Variation within each series does not permit positively establishing this point from the limited observations at hand.

The grass series have shown that in every instance at the time first height measurements are made Series I has made considerably less growth than Series III and IV, and except for mountain brome in 1939 this same relationship holds for the Series II.

In 1938 on date of July 5 -- developmental stage of "heads fully out" -- the mountain brome series had attained a relative average height of 16.05, 17.15, 19.35, and 23.95 centimeters for Series I, II, III, and IV, respectively. Using the Series IV as a base, the relative values are 75, 79, 90, and 100, respectively. The values at end of growing season are essentially of this order. At this same stage of development in 1939 -- after one year of nongrazing use -- the relative height values for these same series was 99, 98, 98, and 100.

When these plants were harvested at the end of the growing season in 1939, it was revealed that Series I, II, and III were essentially alike in size, while Series IV (the previously non-grazed plants) were much larger plants. The relative values were 60, 56, 58, and 100 for Series I, II, III, and IV, respectively. Since the three utilized series are essentially alike with respect to size of plants, it would seem to indicate that the plants making up the non-utilized series are large plants because they are not grazed from year to year. If this is the case, comparisons should be drawn within Series I, II, and III rather than with Series IV. Doing this, one finds that forage production for plants fully grazed (Series I) the first year following this intensity of use is only 83 percent that of plants moderately grazed (Series III).

The Series carried through the seasons 1939 and 1940 were established on an area which is rarely grazed until late summer. With these series it was noted that for mountain brome Series I and II responded very much the same as each other, while Series III and IV respond much alike throughout the entire season. The former two series yielded about 71 and 74 percent that of Series IV. Series III actually yielded more than IV. Relative average heights for the slender wheatgrass plants were 73, 92, 96, and 100 in 1939, and 80, 90, 94, and 100 in 1940, while relative yields in 1940 were 41, 78, 76, and 100 for Series I to IV, respectively. Full use of slender wheatgrass apparently has greater deleterious effect than has that of mountain brome, while this does not seem to be the case for other use classes.

Further to check on these observations, the mountain brome series for 1940 was established on a favorable site, while that for slender wheatgrass was again established on a relatively dry site for this zone. Letterman needlegrass was also established on the same site as was slender wheatgrass.

The first year results for mountain brome and slender wheatgrass varied somewhat from other seasons. Mountain brome showed a gradation in relative height from 65 to 100 for Series I to IV, while the slender wheatgrass Series II, III, and IV all made very nearly the same height growth, these being approximately 20 percent higher than Series I.

Letterman needlegrass responded similarly to the wheatgrass in Series I attaining only 68 percent as great height at the end of the growing season as did Series IV. Series II made only slightly less growth than Series IV, while Series III fully equalled or exceeded Series IV as the season advanced.

These observations indicate that it is the small plants that are grazed to heavy intensities year after year. The cumulative effect of such treatment may not be overcome in one or even two

years' total protection. On favorable sites one year's non-use of mountain brome apparently resulted in full restoration of plant vigor. On drier sites there is but little indication of gain in size of plants for either slender wheatgrass or mountain brome when completely protected for two years. The reasons for selective choice of plants by livestock is not made clear by these observations -- it may be strain differences, wholly a matter of size of plants, or still other factors. One point, however, that does begin to show up is that regardless of size of plant each species does have definite characteristics of resistance to herbage removal that needs be more fully understood before proper-use factors can be accurately determined for each species on various range types.

Spring-Fall Range

Vigor of Bluebunch Wheatgrass. A question of great interest is, "During which season, or period of plant development, is grazing most detrimental to plant vigor?"

The following data and conclusions, relative to this question, are a result of supplementary observations in connection with the 1940 seasonal yield study at the U. S. Sheep Experiment Station. This study consisted of six blocks, or replications, each of 100 evenly spaced plots, 0.83 foot in radius. Each replication was divided into 5 series of 20 plots. On the following dates, April 17, May 2, May 16, June 1, and June 19, one series in each replication was clipped to ground level, and left unused for the remainder of the season. These clipping dates corresponded to the stages of growth and development as shown in tables 1 and 2:

Table 1.--Leaf height at the time of clipping.

Date clipped	Height			
	Basal leaves		Flower stalks	
	Maximum	Average	Maximum	Average
	(cm.)	(cm.)	(cm.)	(cm.)
4/17	10.2	5.9	None	None
5/2	19.9	11.9	None	None
5/16	25.2	16.6	14.0	10.7
6/1	25.2	16.6	33.5	27.4
6/19	25.2	16.6	46.6	38.2

Table 2.--Developmental stages at the time of clipping.

Date	Stage of Development
4/17	Growth started, flower stalks not evident.
5/2	A few flower stalks starting up from the root crown.
5/16	Flower stalks apparent on 36.6 percent and heads apparent on 5.5 percent of the plots.
6/1	Heads fully out on 70.0 percent of the plots.
6/19	Plants in flower on 90.4 percent of the plots.

Then, after fall regrowth reached its maximum, on October 24 and 25, each plot was given a rating--that is, good, fair, poor, and none, on the basis of regrowth vigor. These data are summarized in table 3.

Table 3.--Effect of clipping date on fall regrowth vigor.

Rating	Percent by Clipping Date				
	4/17	5/2	5/16	6/1	6/19
Good	66	21	2	5	37
Fair	26	40	3	27	35
Poor	7	37	68	49	26
None	1	2	27	19	2
Total	100	100	100	100	100
Average[1/]	3.57	2.78	1.79	2.17	3.09

1/ Average vigor rating per plot, computed by assigning numerical values to ratings on the basis that good = 4, fair = 3, poor = 2, and none = 1.

It should be noted that the spring growing season in 1940 had ended before July 1 owing to the scarcity of precipitation. This left approximately 70 days of spring growth after April 17; 55 after May 2; 40 after May 16; 25 after June 1; and only 6 to 10 after June 19. Growth was approaching seasonal maturity in mid-June. Fall regrowth occurred in September and October.

The following conclusions, in summary, become evident on an examination of the above data:

1. The date most harmful to bluebunch wheatgrass, Agropyron spicatum, for a single clipping to ground level was May 16--when the basal leaves attained maximum height, when flower stalks were apparent on one-third of the plots and heads were evident above the boot on only 5 percent. This series produced the lowest percentage of vigorous regrowth. Based on the total number of plots supporting plants at the time of clipping, two-thirds produced regrowth, and on only 2 percent could the regrowth vigor be called good.

2. The second most harmful date was June 1, just before flowering, when 70 percent of the heads were fully out of the boot. Of this series, three-fourths of the plots produced regrowth, 5 percent of which was vigorous.

3. The next date, in order of diminishing effect, was May 2--when the basal leaves had attained 70 percent of their maximum height and when an occasional flower stalk could be found starting up from the crown.

4. The date which ranked fourth in order of decreasing effect was June 19--when the flower stalks reached maximum height, when 90 percent of the plants were in flower, and when the plants were drying.

5. The clipping date which had the least effect on plant vigor was April 17--shortly after growth started, when the average basal leaf height was only 6 centimeters. This series, in addition, produced the highest percentage of vigorous regrowth, two-thirds being classed as vigorous.

If 1940 could be considered a representative year, if fall regrowth vigor is indicative of plant vigor, and if clipping is indicative of grazing influence, it would appear that a single full utilization of bluebunch wheatgrass, Agropyron spicatum, in the early spring--before flower stalks become evident--is less harmful than a single full grazing at any other time during the growing season. Furthermore, these data may indicate another possibility--namely, opening the grazing season for rapid severe use when bluebunch wheatgrass has attained an average leaf height of six inches results in grazing this species at its most critical growing period.

Sheep Grazing in Subalpine Stipa-Chrysothamnus Association. Among a number of small enclosures built in 1913 by A. E. Aldous on high mountain range near the Great Basin branch Station, one remains still effective in excluding livestock. Some decaying pegs inside it mark the corners of a quadrat laid out at that time. The enclosure is in a Stipa-Chrysothamnus association which has been described by Sampson (in Bulletin 791, Plant Succession in Relation to Range Management, 1919) as being one stage below the climax grassland.

In 1940 the quadrat was recharted. Since the outside quadrat could not be relocated for comparison, an area considered closely comparable in site characteristics was selected near the enclosure for comparison. In addition plant counts were made on outside and inside plots each 2.5 x 4 m. in size, and divided into four 2.5 x 1 m. segments. The results reflect the striking contrast observed between the number of plants making up the vegetation outside and inside:

	Outside	Inside
Chrysothamnus lanceolatus	143	225
Stipa lettermani	333	119
Festuca brachyphylla	45	7
Agropyron pauciflorum	38	45
Stipa columbiana	6	6

There are about half as many more plants of Chrysothamnus inside as outside, and the individual plants inside are much larger; inside plants average 35 cm. and outside plants 23 cm. tall. On the other hand, there are almost three times as many plants of Stipa lettermani outside as inside. These differences are not erratic, but are sustained by the individual segments. No single segment of the inside plot has fewer Chrysothamnus or more Stipa lettermani than any one outside segment.

It seems likely that Festuca, a low-growing species, tends to be suppressed by the denser cover of Chrysothamnus inside the enclosure.

For Chrysothamnus to be dominant after 27 years' protection, and for Stipa to flourish under grazing may seem surprising.

When we seek causes, we must first consider climate. The small (about 12x18 ft.) log enclosure, by cutting off wind and by shading the ground, probably creates a more mesic environment than exists on open range. The adjacent range, however, is sheltered by a grove of trees to windward, so that the climatic difference inside and outside the enclosure is probably not extreme.

No particular evidence of rodent burrowing was observed either inside or outside, but what may have happened in this respect during 27 years is not known. The most evident biotic agents are sheep, which have grazed this range closely for many years. The rate of stocking has been reduced from about 1.25 acres per sheep in 1908 to 2.60 acres per sheep at present. Nevertheless even at present the better forage species are very closely utilized. It has been repeatedly noted in recent years that sheep prefer Chrysothamnus to Stipa and Agropyron. It seems as if during the early summer when these grasses are most acceptable, the sheep prefer the broadleaved herbs which are then fresh and succulent. Stipa seeds readily. The sheep take it with more readiness in the fall when rains have softened the herbage. Under grazing, therefore, it appears Stipa may be favored in competition with Chrysothamnus.

A study of the charts made of the meter-square quadrats in 1913 shows that the inside and outside quadrats were essentially similar when they were established except that the outside quadrat, which has been lost, supported a large number of Polygonums (probably P. douglasii) and the enclosed quadrat had none of this species.

Comparing the 1913 and 1940 charts of the enclosed quadrat, the most pronounced change is seen to be an increase in area of Chrysothamnus (from 263 to 4,643 sq. cm.). Of 22 plants present in 1913, 20 still appear to persist in 1940, including plants which are now indistinguishable because their crowns have coalesced. Two have disappeared and 6 new plants have appeared. Thus Chrysothamnus may have a long life span, and is not necessarily killed out by Stipa in a few years.

Although Stipa is the most abundant grass, Agropyron is conspicuous on the 1940 chart. This species does not show in the record of 1913.

Grass as a whole has increased during the 27-year period from 413 to 1,499 sq.cm. -- over threefold. Of 43 plants present in 1913 28 appear to have survived (although some of these are fused together so that today's total would be 24). In addition 17 new Stipa and 21 new Agropyron plants have appeared. Stipa and probably Agropyron seem therefore to be rather long-lived. The bearing of the quadrat evidence on the plant counts described above seems to be that while grasses, predominantly Stipa and Agropyron, increased threefold under protection, they increased about three times faster still, or approximately ninefold, under grazing.

The number of peavines (probably Lathyrus leucanthus) on the enclosed quadrat decreased from 80 in 1913 to 19 in 1940, and the number of dandelions (Leontodon taraxacum) increased from 2 to 5. These are the only two species reported.

If Sampson's concept of succession is essentially correct, and if the normal rate of succession may be supposed to be approximated by protection in a small enclosure, then grazing by sheep in this association accelerates the successional process to a more rapid rate than would obtain under no grazing. This successional process results in a less desirable sheep range, so that by promoting the process the grazier may be defeating his own purpose.

Northern Rocky Mountain

Continued range recovery from the 1934 and 1936 drought years during a quite favorable season at Miles City is evidenced in two ways -- by a general increase in density of quadrats and by an increase in cow months' feed furnished by the cooperative experimental pastures. Quadrat compilations have not been completed but the total increase in density on one heavily grazed pasture amounted to 24 percent over 1939. A 60-percent increase in grama was one of the largest items in this total. Cow months' feed from cattle pastures, which is a rather complete measure of forage production, has been better than since 1933. This, taken in connection with very satisfactory weights of weaning calves, indicates that this short-grass range has staged a remarkable comeback from the low point of early 1937.

Calves from three lots of 20 cows grazed at three intensities were weaned on October 30, with the following results:

Overgrazed range	14 calves	365.1 pound average
Moderately grazed range	17 "	434.2 " "
Lightly grazed range	14 "	420.5 " "

These are mainly April and May calves and the relationship between the average weights by intensities is similar the past season to that of six previous calf crops. Actually, the excess of 69 and 55 pounds for calves on moderately and lightly grazed pastures was a little greater than the past average but part of this is due to an unfortunate change from use of one instead of six bulls for the 60 cows, which resulted in younger calves in one or two of the replicated pastures. Also the total calf crop was not up to expectations for such a favorable year. A substantial difference remains after removal of variation due to this change in breeding practice to confirm previous data showing that heavy grazing of such range is currently unprofitable as compared to moderate or light use. This disadvantage promises to widen during drought years or when the effects of heavy use are reflected by reduced forage on heavily grazed ranges. These short-grass ranges have proved remarkably resistant to such use over an 8-year period but, even so, the current results show the fallacy of heavy grazing.

The seasonal gains by yearling ewe lambs on heavily grazed ranges were likewise less by up to 15 percent than those with a more liberal amount of range but the differences are not so striking as in the case of cattle. Rapid recovery of forage in sheep pastures has, however, overreached the increases in stocking and thus cancels out a portion of the effects of grazing at intensities planned in the case of sheep. Coyotes have also been a disturbing factor in this test.

Pacific Northwest

Publications Being Pushed. Almost 100 percent of Pickford's and Reid's time during the past year has been expended on getting manuscripts in shape for publication. The results of this effort so far include an article of general nature on range surveys that was published in the March number of Herbage Reviews and has since been distributed in mimeographed form to more than 1,300 individuals, both within and outside the Service. The study of range survey methods has been written up and is now in the hands of a board of review. When this manuscript is revised and re-edited in the proper manner, it is intended to be published as a departmental technical bulletin. Another manuscript, intended for publication as a departmental circular and dealing with guides to inspection of subalpine grassland ranges, is in a similar status. Reid is now working on a short journal article dealing with the relative effectiveness of the ocular-by-plot and the stubble-height methods of estimating percentage utilization of range grasses, and their practical application to range inspection work. Pickford is now writing a short article for a livestock journal, dealing with the range forage requirements of elk in the Blue Mountains. Several more articles covering details of the past four years' effort in range research at this Station are in the course of preparation and will be ready for publication before the opening of the 1941 field season.

Use of Summer Range Forage By Elk. Elk are increasing so rapidly in parts of the Blue Mountains in Oregon that attempts to improve forage conditions by regulating the use of the range by livestock largely are nullified because of the steadily growing intensity of forage use by elk. On the Whitman National Forest, a sheep range in 1937 produced 1,424 pounds of forage per acre (green weight), 21.6 percent of which was utilized by sheep and the elk that were then present on the area. The allotment was closed to sheep grazing in 1938. In 1940, utilization surveys showed that forage use by elk amounted to 193.2 pounds per acre (green weight), or 13.6 percent of the 1937 forage production. The number of elk using the area is not known, but it is safe to say that they have increased until they are now using 63 percent as much forage as did the sheep and elk together in 1937. Studies made by E. P. Cliff on the Whitman in 1938 show that an annual increase of 18.4 percent

can be expected in the Whitman elk herd under the present hunting law. Applying this rate of increase to the local herd it is possible that numbers of elk have nearly doubled in the 4-year period.

The forage preferences of elk and sheep are not entirely similar but are sufficiently so that a real conflict may occur where considerable numbers of the two classes of animals graze in common. For example, the sheep diet was composed of 33.06 percent grasses, 66.16 percent weeds, and 0.78 percent shrubs on the area studied. The elk diet consisted of 13 percent grasses, 80.94 percent weeds, and 6.06 percent shrubs. Fleeceflower (Aconogonum phytolaccaefolium), which made up 47.42 percent of the vegetation by weight, composed 23.70 percent of the sheep diet and 61.48 percent of the elk feed. Elk sedge (Carex geyeri), which is the most important forage plant on the area potentially and is probably a climax species for the type, was 2.06 percent of the herbage produced, 3.75 percent of the sheep feed, and 5.69 percent of the elk feed. Elk alone were found to have grazed Parry rush (Juncus parryi), Wyeth eriogonum (Eriogonum heracleoides), elk sedge (Drymocallis glandulosa), sweet-anise (Osmorhiza occidentalis), arrowleaf butterweed (Senecio serra), big sagebrush (Artemisia tridentata), snowbrush (Ceanothus velutinus), and gooseberry currant (Ribes montigenum) to a greater intensity in 1940 than did sheep and elk in 1937.

Rocky Mountain

Cattle Weight Gains on Short-Grass Ranges. The 1940 grazing season on the Central Plains Experimental Range was closed November 25. Composite analysis of cattle weights and gains, vegetation, and climatic records will require several weeks although certain preliminary figures are available.

The monthly and seasonal gains for 1939 and 1940 have been summarized for the 300 yearlings grazed under experimental control:

Average monthly and seasonal gain for 300 head

Month	1939 gain (lbs)	1940 gain (lbs)
May	50	83
June	71	70
July	44	67
August	28	49
September	18	26
Total	211	295

The differences in monthly and seasonal gains for the two years are largely a reflection of differences in weather and forage

supply. In 1939 the worst drought on record was experienced, there being no effective precipitation from the end of May until January 1, 1940.

Forage reserves were exhausted by September 30 and the cattle were removed from the experimental range. In 1940 precipitation has been slightly in excess of the annual average of approximately 14 inches. Rains amounting to approximately 5 inches fell on July 2 and 3 and the resulting forage growth provided ample feed for the season on all but the overgrazed pastures.

A comparison of weight gains made by steers and heifers of the same age and grazed in the same pastures indicates that steers will gain 18 to 20 pounds more per season than heifers.

Yearling Herefords grazed on abandoned plowed fields, characterized by various plant succession stages in which weeds and coarse grasses were prominent, gained from 60 to 70 pounds more than similar animals grazed on native ranges characterized by blue grama (Bouteloua gracilis) and buffalo grass (Buchloe dactyloides). A chemical study of the principal plant species involved may be necessary to determine their relative nutritive value as a basis of explanation for this difference in weight gains.

Several complications are anticipated in analysis of the weight data for cattle stocked at different intensities in 1940. For example, certain experimental pastures have received 4 inches more rainfall than others during the current season and the resulting differences in forage production must be considered before treatment effects of different rates of stocking are segregated.

Management of Sheep. The two bands of sheep studied during the summer of 1939 were studied again in 1940. The general habits, daily routes of movement, use of bedgrounds, number and causes of losses and other data indicating the relationship between management and losses were obtained each season. The results strikingly illustrate the benefits of good management in reducing losses and increasing income.

In 1939 the very poorly managed band (1) lost 52 ewes and 107 lambs, or 5.5 and 12.1 percent from all causes. The other, and better managed band (2), lost 37 ewes and 43 lambs, or 3.7 and 4.6 percent. The 1939 loss for all animals was 8.68 percent for band 1 and 4.15 percent for band 2. In addition to this difference in loss, the lambs of the better managed band averaged 8.2 pounds heavier than the lambs under poor management. Altogether, the better management resulted in 10,075 more pounds of meat and a $916.82 greater gross income.

Although the allotments were adjacent, forage conditions were not entirely comparable and it was not quite correct to assign the difference in gross income to management alone. However, in 1940, the management of the two bands was reversed in such a manner as to clearly show the effect of management on gross income.

The owner of the band that was so poorly handled in 1939, adopted during 1940 many principles of management which we recommended for this band. In contrast, the band that was under fair management in 1939, reverted to poor management conditions in 1940 principally because a good herder was replaced by a very poor herder.

For direct comparison, the losses in percent for both bands during both years are given in the accompanying table.

Year	Ewes		Lambs		Total	
	Band 1	Band 2	Band 1	Band 2	Band 1	Band 2
1939	5.5	3.7	12.1	4.6	8.7	4.2
1940	3.6	6.1	6.3	7.4	5.0	6.7

The lambs of band 1 sold for an average of $6.08 each in 1939 and $6.06 each in 1940. A slight difference in average weight was balanced by a slight price difference. However, because of a higher lamb crop (due to culling) and less loss (due to improved management) in 1940, the gross income per ewe in 1940 was $6.00 as compared to $5.00 in 1939. The owner grossed $998.00 more from 998 ewes in 1940 than in 1939 with practically no additional expense by judicious culling and improved management.

Southwestern

Inter-Agency Range Survey Committee Meeting. The Southwestern Inter-Agency Range Survey Committee, which meets semiannually to discuss range survey problems, elected to hold its fall meeting at the Santa Rita Experimental Range for a field demonstration on methods of measuring utilization and to look over range investigations in progress.

The meeting was held on November 7, 8, and 9. Arrangements for accommodations were made at Santa Rita Headquarters, and meals were provided at cost. In addition to the regular members of the Committee, representatives from all Federal and state agencies interested in range management were invited, and as many agencies took advantage of the opportunity to have their men see the work at the Santa Rita, the total attendance included 47 persons.

Representation by agencies was as follows:

AAA (Arizona and Washington, D.C.)	3
BAE (FCS, New Mexico and Texas)	2
Grazing Service (Arizona and Utah)	2
Fish and Wildlife Service (Research, Arizona)	1
Forest Service (Administration, Ariz. & N. Mex.)	7
Forest Service (Research, Southwestern)	5
Indian Service (Ariz., N. Mex., & Washington, D.C.)	20
Soil Conservation Service (Ariz., N. Mex., and Washington, D.C.)	4
Arizona Agricultural Experiment Station	2
New Mexico State College	1

Washington representatives in attendance included LeRoy D. Arnold, acting director of forestry for the Indian Service, George E. Bradley of the Agricultural Adjustment Administration, and F. G. Renner, chief, Range Conservation Division of the Soil Conservation Service.

The general program was divided into three parts with one day devoted to a tour of the range, one day spent on utilization studies, and a half day on general discussions.

The tour over the experimental range included field inspection and subject consideration as follows:

(a) Survival and spread of native grasses which had been seeded or transplanted in 1936. Several species of grama, particularly black, side-oats, and slender (Bouteloua eriopoda, Bouteloua curtipendula, and Bouteloua filiformis), have become well established and have spread to adjacent areas. Tanglehead (Heteropogon contortus), a warm-climate bunchgrass, has shown outstanding results, having become established over a considerable area.

(b) Problems of shrub control with particular attention given to burroweed and mesquite. The results of various control methods were demonstrated and discussed.

(c) Experimental work of the Range Ecology Department of the Arizona Agricultural Experiment Station on jackrabbit feeding whereby the College investigators are attempting to determine how much forage rabbits consume and the "palatability" of the native species.

(d) New shrub-control installation designed to study the effect of shrub competition on the growth of grasses. This experiment is laid out in the form of a 4x4 Latin

square with the following treatments: (1) check - no treatment; (2) mesquite killed; (3) burroweed grubbed; (4) mesquite and burroweed both killed. Changes in vegetation are recorded by quadrats, line transects, and photographs.

(e) Studies, by the nursery section of the Soil Conservation Service in cooperation with the Southwestern Station, with introduced forage grasses. Several of these, notably species of Eragrostis and Panicum, are showing considerable promise.

Utilization studies occupied the second day and involved making individual estimates of utilization on two series of plots, one series located in a typical black and Rothrock grama area and the other located in a mixed grama type where hairy, sprucetop, and slender gramas were dominant. Prior to the meeting, four plots (4'x25') had been laid out in each of the two localities. Three of the plots in each series were clipped to represent various degrees of utilization, and one was left unclipped to serve as a check. The group was divided into three squads, and each individual was supplied with a mimeographed card on which to enter his estimates. Each individual estimated density, composition, and utilization on all of the clipped plots. Each observer was first asked to estimate actual utilization according to his own ideas; then the stubble-height method was explained, and each individual estimated utilization independently using this method. Each squad was then supplied with scissors, sacks, a yardstick, and scales and, under the squad leader's direction, clipped average plants in 1- and 2-inch segments in order to determine height-weight relationships. Using the information thus secured, each individual estimated utilization on the volume basis. On the mixed grama plots, a fifth of the check plot was clipped to give the observers an idea of the total weight of forage produced by the various species, and on this basis utilization estimates were made by the ocular-by-weight method. At the end of the day all cards were turned in so that means could be determined. The cards were returned to the individuals the following mornong, and during the ensuing discussion, the mean of all estimates as well as the actual utilization, as determined by clipping and weighing, were furnished so that each individual could see how closely his estimates conformed with the mean of the group and with the actual measured utilization.

The results of this study showed that there was close agreement between all individuals and between agencies in the estimating of density and composition. Estimates of percent proper utilization on a volume basis and by the stubble-height method were in close agreement although many individuals had difficulty in understanding the stubble-height method. The volume estimate and the ocular-by-weight methods gave results that approached the actual utilization.

The volume method gave more uniform results and more closely approached the actual utilization. The ocular-by-weight method tended to give figures representing a greater degree of use than had occurred.

As a result of the tests and the discussion on the third day, the majority of the group was convinced that utilization estimates should be based on weight or volume or both and that our present proper-use factor tables need revision in order to express true values on the basis of the percent of forage available on properly used ranges.

COOPERATING BUREAU PROJECTS

BIOLOGY

(In cooperation with the Bureau of Biological Survey)

Lake States

Due to increased funds available for biological research, the Fish and Wildlife Service has been able to assign an assistant to S. E. Aldous, the Station Biologist. Mr. Robert Gensch, a native of Wisconsin and a graduate forester-biologist of the University of Michigan, reported for work in November. He will be stationed in the field on the Nicolet Forest and will devote his time mainly to studies of the snowshoe hare in relation to reforestation.

Northeastern

Effective August 16, Biologist John Pearce who has been conducting the program at this Station was transferred as Leader to the Maine Cooperative Wildlife Research Unit, University of Maine, at Orono.

Due to defense program emergencies, plans for uninterrupted continuation of forest-wildlife investigations have been delayed. Under the proposed program a biologist would be located at the Massabesic Experimental Forest in Maine. This location would enable wildlife investigations in the white pine type to go on simultaneously with the initiation of silvicultural and management studies on the Experimental Forest. Both the Gale River and Bartlett Experimental Forests in New Hampshire are within easy reach of the Massabesic Forest.

RANGE BIOLOGY

Southwestern

A. H. Trowbridge, Junior Biologist, Fish and Wildlife Service, Department of Interior, was assigned, under McSweeney-McNary Forest Research Act appropriations to the Southwestern Station late in September 1940 and will work under the supervision of Biologist E.E. Horn, stationed with the California Forest and Range Experiment Station at Berkeley. The research program upon which Trowbridge will engage is now being developed cooperatively and for the present will deal principally with range rodents. It will undoubtedly involve (1) developing techniques for determining rodent populations on the range as a guide to estimating the annual rodent pressure; (2) determining the damage done by rodents to ranges at various population levels; (3) the effects of rodents on forage density, composition, and regeneration; (4) following up certain long-time studies initiated by W. P. Taylor, who discontinued his work at this Station in 1935.

Mr. Trowbridge's headquarters for the present will be at the Santa Rita Experimental Range, although his work will take him onto the range lands of all ownerships throughout the State. He will also keep in touch with the work on small rodents being done by Jack Welch, of that Service, cooperatively with the Southwestern Station on the Cloudcroft Experimental Forest in New Mexico.

ENTOMOLOGY

(In cooperation with the Bureau of Entomology and Plant Quarantine)

Appalachian

Tree Injection. An organic chemical that is claimed by the manufacturers to have good insecticidal and fungicidal values was inoculated into several large healthy loblolly pines on the Santee Experimental Forest in October. As checks against these treatments, some large loblolly pines were injected at the same time with copper sulphate.

All the loblolly pines treated in April with inorganic wood preserving salts were examined in October for insect and stain development. Those that had been felled in May, and a few felled in October, were sectioned into 10-foot lengths and left for service tests. Wood samples for quantitative analyses were collected from all the logs of the copper sulphate treatments.

Large shortleaf pines treated in June with inorganic wood preserving salts at the Bent Creek Experimental Forest were felled and, like those cut in September, were sectioned into 10-foot logs

and exposed for service tests. Wood samples for chemical analyses were taken from the trees treated with copper sulphate.

Wood samples were collected for chemical analyses from sections of shortleaf pines treated in 1935 with copper sulphate. These analyses of 1940 samples are to be used for comparative studies with the analyses made of samples taken in 1935.

Termite Control. Fibre-board samples treated with chemical preservatives by the Johns-Manville Corporation set out in a cooperative study at the Santee Experimental Forest in 1939 were inspected and reported on regarding termite infestation.

For service tests fresh samples of treated fibre board from the Johns-Manville Corporation were set out during October at the Santee Experimental Forest.

Bark Beetles. An infestation of Ips engraver beetles on pines at Lookout Mountain, near Chattanooga, Tennessee, was investigated. Suggested measures for prevention and control were recommended.

Northeastern

Defoliation by Ellopia athasaria. Reports on the recovery of hemlock trees which were severely defoliated in 1934 by Ellopia athasaria Walker, indicate that those less than 95% defoliated are still in good condition.

A local outbreak occurred in Warwick, Massachusetts, in 1934 where, in September, the trees on some 12 acres in practically a pure stand of hemlock were seriously defoliated. Sixty trees in this area were marked for observation concerning their recovery. These trees varied from 4.8 to 12 inches D.B.H., averaging about 9 inches, and the estimated defoliation ranged from 70 to 100 percent. Their rating as to crown classification was as follows: 15 dominant, 16 co-dominant, 13 intermediate and 16 suppressed. The site is considered very favorable for hemlock, and there has been no serious defoliation since 1934.

The following table shows a classification of the estimated degree of defoliation for the 60 trees in the fall of 1934, the crown classification in 1934 and the condition as noted on October 24, 1940:

Percentage of defoliation	No. of trees	Crown Classification				Condition of trees on Oct. 24, 1940				Uprooted in 1938 hurricane
		Dom.	C.D.	Int.	Sup.	Good	Fair	Poor	Dead	
70	1	0	0	0	1	1	0	0	0	0
75	3	0	0	1	2	3	0	0	0	0
80	6	2	1	1	2	4	0	0	0	2
85	10	2	1	2	5	6	0	0	0	4
90	13	3	5	2	3	11	0	0	0	2
95	15	4	5	3	3	9	4	0	1	1
95-100	12	4	4	4	0	1	1	1	9	0
Totals	60	15	16	13	16	35	5	1	10	9*

* These 9 trees were alive at the time they were uprooted in 1938, but since then 3 of them have died.

It is believed the above data are representative of the entire area affected. The results definitely indicate that thrifty hemlock trees will tolerate considerable defoliation late in the summer, when the current year's growth is nearly mature, and stand a good chance of recovering. However, if the degree of defoliation exceeds 95 percent a high mortality may occur.

Local outbreaks occurred this year in New Haven County, Connecticut, in two natural stands of hemlock which are separated by a distance of some 10 miles. In each stand the hemlock trees on some 5 acres were seriously defoliated and the owners are much concerned about the possibility of the trees recovering. This prompted a check-up on the 1934 infestation at this time.

E. athasaria Walker (Family Geometridae) passes the winter in the pupal stage in the duff. The larvae are normally active from late in July to the latter part of September, but this year a few larvae were found in Connecticut as late as October 22nd.

Matsucoccus Injury Increases in Pennsylvania. T. J. Parr of the New Haven, Conn. laboratory reports as follows on an examination of pines in Pennsylvania infested with Matsucoccus gallicolus: "The period October 16 to 19 was spent taking notes on the condition of pitch and shortleaf pines in the infested plots at Mont Alto and Mount Union, Pa. These plots, with the exception of one at Mt. Union, appear in worse condition than they did last year. The exception is a natural stand, where there is some decrease, both in number of twigs and leaders killed this year.

"The following table gives a brief summary of twigs and leaders killed on these plots during the past three years:

Plot no.	Species	Location	Current twigs killed			Current leaders killed			Plot trees dead (percent of)			Total no. of trees dead
			1938	1939	1940	1938	1939	1940	1938	1939	1940	(percent)
I	Pitch pine plantation	Mont Alto, Pa.	2393	3262	3824	56	61	75	0	2.8	2.1	4.9
II	Short leaf natural stand	Mont Alto, Pa.	216	316	564	20	22	17*	8.26	7.6	12.8	26.03
III	Pitch pine plantation	Mount Union, Pa.	173	169	401	0	0	2	0	0	0	0
IV	Pitch pine plantation	Mount Union, Pa.	939	757	1604	26	21	21	0	2.8	0	2.8
V	Pitch pine natural stand	Mount Union, Pa.	1237	1295	1000	27	24	16	0	0	0	0

* Many of the trees which had leaders killed on this plot last year died in 1940."

Decrease in Beech Scale Infestation in Maine. L. D. Casey of the New Haven, Conn. laboratory reports as follows: An examination of permanent beech scale-Nectria plots in Maine made in September showed that in nearly all of the plots the scale infestation was lighter than last year. There were only two of the plots in which the infestation showed a slight increase. Nectria infection has increased in most cases and has spread to new trees. In the Liberty plots there was no mortality of beech which could be attributed to the scale or Nectria. In some cases the decrease in scale infestation was due to dying bark on sections of the trees especially in the case of the larger trees. In Washington County there were two plots in which a few trees had died and several others were in a weakened condition. This was caused, it is believed, by scale infestation and Nectria infection. It appears now that there will be a considerable mortality of beech in the vicinity of these two plots within a year or so.

During July five beech scale-Nectria study plots consisting of 50 trees each were established in Westchester County, N. Y., These plots were all lightly infested with scale but there was no Nectria infection found.

Southern

At the Soil Conservation forest nursery at Thorsby, Alabama, subterranean termites caused a 1 percent loss of 1-0 white ash seedlings.

Cages have been constructed so that the tests of metal termite shields can be continued during the winter in a heated greenhouse at Saucier, Miss. An illustrated report on these tests is being prepared.

Christian reported on October 14 that the flat oak borer, Smodicum cucujiforme, caused considerable damage to oak lumber in southeast Texas; in some mills the damage was greater than that caused by Lyctus powder-post beetles.

The medicated tree sections from Asheville were inspected by Johnston and Dr. Verrall at Saucier, Miss., on October 24, and a special report was prepared on the results.

Ambrosia beetles have not been very active since the coming of cool weather, but observations on the biology of these insects will be continued during the winter. An illustrated paper on the biological studies of certain ambrosia beetles is being prepared by Johnston.

On October 28 - 30, Snyder attended the annual convention of the National Pest Control Association at Indianapolis, Ind., and took part in the program.

Snyder made an inspection on October 31 of army supplies at the Quartermaster Depot, Jeffersonville, Ind., and gave advice on the prevention of damage by powder-post beetles. Advice was also given on the control of termite damage to buildings.

The 12th progress report on the International Termite Exposure Test by G. M. Hunt and T. E. Snyder has been approved for publication in the Proceedings of the American Wood Preservers' Association. Results of other wood preservative tests in Panama were tabulated on 5 x 8 cards, but these records are still not up to date.

During the week of November 25, representatives of the Bureau of Entomology and Plant Quarantine and the Forest Service installed several chemical fumigants or toxics in nests of the Texas leaf-cutting ant in efforts to discover safer methods of control. These experiments were conducted on the Kisatchie National Forest near Alexandria, La. During the first day's work, representatives of the office of the State Entomologist were present in the field.

PATHOLOGY

(In cooperation with the Bureau of Plant Industry)

Appalachian

Little-leaf Disease. Additional little-leaf disease on short-leaf pine has been found in some south-central counties of Virginia and in Davie, Polk, Rutherford, and Mecklenburg Counties in North Carolina. The roots of little-leaf trees have been found to be much inferior to those of healthy trees with respect to number of feeding roots, condition of mycorrhizae, and general color and turgidity of the bark of the larger roots. Analysis of weather records has revealed no correlation of weather with the disease thus far. Additional study plots have been established in northwestern Alabama. To date, the most consistent habit of little-leaf is its occurrence almost invariably on relatively poor land. So far, little-leaf has not been found on the more gently rolling better farm lands of the Piedmont. A report stating the progress made since July 1, 1940, in the investigation of this disease is about to be issued and will be made available to interested parties.

Hardwood Cankers. Two areas of heavily cankered hardwoods, of 188 and 11 acres, respectively, mostly oaks, in western Maryland, had cankers eradicated from them in 1933. During October of this year these areas were re-eradicated and the number of new cankers formed in the interim was recorded. Plots for permanent observation were established in the middle of the two eradication areas. Check plots in uneradicated areas have also been maintained. Indications, pending analysis of data, are that eradication has not cut down subsequent cankering to a significant degree. The first eradication, however, done with CWA labor, was not complete, and many cankers that are recorded as new were undoubtedly left during the first eradication.

Southern

Fusiform Rust of Southern Pines. The fusiform rust of southern pines occurs in varying severity throughout the southern half of the Gulf region. Within the heaviest infection-zone considerable variation in amount of the rust is sometimes encountered over relatively short distances, even on the same species of pine. Pathological surveys made systematically in such marginal areas should indicate the reasons for these differences in incidence of the disease. Field surveys were started in October and November to locate areas where methods to determine the rust hazard for different planting sites could be worked out.

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MANUSCRIPTS

Appalachian

Cruikshank, J. W.	The forest resources and industries of North Carolina. Accepted by Southern Lumberman.
Hepting, G. H.	The prediction of decay following fire in Appalachian oaks. To Jour. Agr. Res.
Hoffmann, C. H.	Biological observations on Xylosandrus germanus Bldfd. (Coleoptera Scolytidae). Accepted by Jour. Econ. Ent.
Hursh, C. R.	The naturalization of road banks. Submitted as Forest Service Circular.
Roth, E. R.	Top rot in snow-damaged yellowpoplar and basswood. To Jour. For.
Toole, E. R.	Fusarium wilt of the mimosa tree (Albizzia julibrissin). To Phytopath.

California

Bruce, H. D., Crafts, A. S., and Raynor, R. N.	Plot Tests with chemical soil sterilants in California. (For publication by Univ. of California as an Agric. Expt. Station Bul.)
Fowells, H. A.	The period of seasonal growth of Ponderosa pine and associated species. (For Jour. of For.)
Hasel, A. A.	Estimation of vegetation-type areas by linear measurement. (Jour. For.)
————	Estimation of volume in timber stands by line-plot sampling. (For. Jour. Agr. Res.)
Mirov, N. T.	Distribution of growth hormone in shoots of two species of pine. (For Jour. For.)

Lake States

Bates, C. G. and Stoeckeler, J. H.	Snowdrift control on highways by planting of trees and shrubs. (For Eng. News Record)
Eyre, F. H., and Lebarron, Russell K.	Silvicultural management of jack pine in the Lake States. (Proposed Tech. Bul.)
Roe, Eugene I.	Effect of temperature on seed germination (For Jour. For.)

Pacific Northwest

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